

**REPORT OF  
AIR POLLUTION SOURCE TESTING  
OF AN ETHYLENE OXIDE EMISSION-CONTROL SYSTEM  
OPERATED BY STERIGENICS, US, LLC  
IN WILLOWBROOK, ILLINOIS  
ON SEPTEMBER 21, 2018**

**WILLOWBROOK I FACILITY**

Submitted to:

**ILLINOIS ENVIRONMENTAL PROTECTION AGENCY  
1021 North Grand Avenue East  
Springfield, Illinois 62794**

Submitted by:

**STERIGENICS US, LLC.  
2015 Spring Road  
Oak Brook, Illinois 60523**

**I.D. Number 043110AAC**

Prepared by:

**ECSI, INC.  
PO Box 1498  
San Clemente, California 92674-1498**

Revision 1

**OCTOBER 30, 2018**

*ECSi*

## CONTACT SUMMARY

### CLIENT

Mr. Kevin Wagner  
Director of Environmental Health and Safety  
STERIGENICS US, LLC.  
2015 Spring Road, Suite 650  
Oak Brook, Illinois 60523

Phone: (630)928-1771  
FAX: (630)928-1701  
email: [kwagner@sterigenics.com](mailto:kwagner@sterigenics.com)

### FACILITY

Mr. Paul Krett  
General Manager  
STERIGENICS US, LLC.  
7775 Quincy Street  
Willowbrook, Illinois 60521

Phone: (630)654-5151  
FAX: (630)325-0020  
email: [pkrett@sterigenics.com](mailto:pkrett@sterigenics.com)

### TEST DATE

Friday, September 21, 2018

### REGULATORY AGENCY

Daniel Rowell  
Environmental Protection Engineer III  
Bureau of Air – Air Permits Section  
Illinois Environmental Protection Agency  
1021 North Grand Avenue East  
Springfield, Illinois 62794-9276

Phone: (217)558-4368  
FAX: (217)524-5023  
Email: [daniel.rowell@illinois.gov](mailto:daniel.rowell@illinois.gov)

### TESTING CONTRACTOR

Daniel P. Kremer  
President  
ECSi, Inc.  
PO Box 1498  
San Clemente, California 92674-1498

Phone: (949)400-9145  
FAX: (949)281-2169  
email: [dankremer@ecsi1.com](mailto:dankremer@ecsi1.com)

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## 1.0 INTRODUCTION

Revision 1 was completed at the request of USEPA and IEPA. Revisions made to the report include:

- Report address changed on page i for General Manager Paul Krett to reflect Willowbrook I facility address.
- Conversion made from wet ppm to dry ppm formula added to Section 5.9.
- Section 8.0 Test Results show efficiency changed from  $\geq 99.6179$  to  $\geq 99.6132\%$ .
- Tables 1 and 2: Added columns to show dry ppm conversion values for inlet and outlet concentrations
- Tables 1 and 2: Included moisture/temperature calculation averages for each run.
- Tables 1 and 2: Mass Flow values were previously calculated in lbs./second and labeled lbs./minute. Edit made to show values in lbs./minute.

On Friday, September 21, 2018, ECSi, Inc. performed air pollution source testing of an ethylene oxide (EtO) emission-control device operated by Sterigenics US, LLC at their Willowbrook I ethylene oxide sterilization facility located at 7775 Quincy Street. The control device tested was a two-stage Advanced Air Technologies (AAT) Safe Cell emission-control system, comprised of a packed-tower chemical scrubber and a dry-bed reactor, used to control emissions from fourteen sterilizer backvents, and three aeration rooms.

The purpose of the testing program was to demonstrate compliance with the conditions established in Section 6 of the Construction Permit (Application No: 18060020) granted to Sterigenics by the Illinois Environmental Protection Agency (IEPA) to control emissions from the sterilization chamber backvents. See Appendix L.

Test Protocols were submitted and approved by IEPA prior to testing. Copies of protocols and approval are included with Appendix L.

Representatives from Sterigenics were present during the testing as well as personnel listed below:

- Kevin Mattison, IEPA
- Ned Shappley, US EPA, OAQPS
- Margaret Sieffert, US EPA, Region 5
- Paul Farber, PE (Consultant for Village of Willowbrook)
- Lawrence Link, Tri-State Fire Department

## 2.0 EQUIPMENT

The gas sterilization and emission control equipment in Willowbrook I consists of the following:

- Fourteen Sterilizers, each comprised of a steam-heated sterilization chamber, a vacuum pump chamber evacuation system, and a backvent valve;
- Three aeration rooms, each comprised of a heated aeration space.

Chamber vacuum pump emissions are controlled by:

- One Chemrox DEOXX packed tower chemical scrubber, equipped with a packed reaction/interface column, a scrubber fluid recirculation system, and a scrubber fluid reaction/storage tank.

Chamber backvents, and aeration emissions are controlled by:

- One two-stage Advanced Air Technologies (AAT) Safe Cell emission-control system, comprised of a packed-tower acid/water scrubber (SC1), equipped with a packed reaction/interface column, a scrubber fluid recirculation system, and a scrubber fluid reaction/storage tank, and a dry bed reactor/scrubber (SC2), comprised of a bank of solid-bed reaction vessels containing Safe-Cell IIA Reactant for EtO control, connected in parallel, installed downstream of SC1 and upstream of a dedicated blower exhaust system designed to operate at 15,500 cfm.

The facility has also been granted permission in its permit to direct chamber vacuum pump emissions to the AAT system. This operating scenario is rarely utilized, and will not be studied in this testing program.

### 3.0 RULE/COMPLIANCE REQUIREMENTS

The EtO gas-sterilization system at the Willowbrook I facility was tested to demonstrate compliance with requirements specified in the Construction Permit issued by IEPA (Application No: 18060020) and CAAPP Permit No: 043110AAC. The following requirements must be met:

- The existing emission control equipment for chamber exhaust and aeration room emissions is required by 40 CFR Part 63, Subpart O to achieve a control efficiency of 99% or greater.
- Chamber backvent emissions are not regulated through the federal regulations at 40 CFR Part 63, Subpart O. By way of permit application 18060020, Sterigenics has voluntarily elected to control backvent emissions using existing emission control equipment at the facility already required to achieve 99% or greater control efficiency.

Testing is required to demonstrate continued compliance with these requirements.



## **4.0 TESTING**

EtO source testing was conducted in accordance with the procedures outlined in US EPA Reference Methods 2, 3, 4 and 18. EtO emissions monitoring was conducted simultaneously at the inlet and outlet of the AAT System during the 15-minute duration of the backvent process. Three 15-minute test runs were performed.

### **4.1 TEST SCENARIO**

Once a sterilization chamber cycle ends, a sample from inside the chamber is taken and measured to ensure the EtO concentrations are below 25% of the lower explosive limit (LEL) for safety reasons. Current controls interlocks will not allow the doors to be open if the concentration of EtO at the end of a cycle exceeds 25% LEL. Once this criterion has been met, the process requires the chamber door to be partially opened for 15 minutes which vents the EtO in the chamber to reduce levels in the chamber and exposure to employees. The 15-minute duration ensures the highest concentration of EtO is removed from the chamber prior to unloading the product. During this venting, EtO exhausts through the backvent and to the AAT scrubber. In accordance with the facility's procedures, workers are not allowed to enter or unload the chamber until the 15-minute time period has passed. Once the 15-minutes has passed, the product is unloaded to the aeration room.

To meet Condition 6 of the Construction Permit which requires conditions for testing to be conducted as representative of maximum emissions, each test run was completed on the backvents using freshly sterilized product from one chamber for a 15-minute duration, for a total of three test runs at each facility. The emission testing of the sterilization chambers occurred while running FDA validated cycles with higher ending EtO concentrations for testing. Each test interval tested the first 15 minutes the backvent is opened and exhausted to the AAT scrubber.

### **4.2 PROCESS PARAMETERS MONITORED**

Based on the overall AAT scrubber liquor storage volume, relatively short duration of the test, and knowledge of the operation of the AAT system, the properties of the AAT scrubber liquor were not expected to change significantly during the test. Because of this, the AAT Scrubber tank level, pH, and

glycol concentration (measured via refractometer) were monitored and recorded before and after the performance of the three trial runs. Results are presented in Appendix A.

Cycle information for each test run, including ending EtO concentration in the chamber space, also was provided. Emission levels from aeration also were recorded before performance of the three test runs. Results are presented in Appendix A.

During routine operations, weekly concentration sampling of the AAT system is conducted using samples collected from the AAT system outlet using a Tedlar bag and the facility's gas chromatograph system. Since this performance testing involved real-time analysis of the inlet and outlet concentrations of the AAT system, Tedlar bag sampling was not conducted during these tests.

#### **4.3 TESTING EQUIPMENT**

Testing equipment information and certifications are located in Appendix G.

## 5.0 TEST METHOD REFERENCE

### 5.1 INTRODUCTION

EtO source testing was performed in accordance with US EPA Reference Methods 1, 2, 3, 4 and 18. EtO emissions monitoring was conducted simultaneously at the inlet and outlet of the AAT System during each 15-minute duration of the backvent process. A total of three test runs was performed.

During backvent testing, EtO emissions at the inlet and the outlet of the AAT Safe Cell System were determined using direct source sample injection into the gas chromatograph (GC). The GC used to analyze EtO concentrations was a SRI Model 8610 (also described in Section 5.3).

US EPA Method 1: Sample and Velocity Traverses for Stationary Sources (40 CFR 60 Appendix A)

Sample ports and flow traverse locations were located at the inlet and outlet of the AAT control device. Numbers of flow traverse locations were selected to exceed those recommended by Tables 1.1 and 1.2, and were spaced throughout the duct in accordance with Method 1. The average angle of cyclonic flow at each traverse point was less than the maximum average angle specified in Method 1. For further information on sample port locations, sample and velocity traverses, and cyclonic flow measurements please see Appendix B.

US EPA Method 2: Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube) (40 CFR 60 Appendix A).

The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) Pitot tube. This method was used in its entirety as per the procedures outlined in Method 2.

ESCI performed a cyclonic flow check and velocity traverse using an S-type Pitot tube in each duct prior to the first test run. These results were used to calculate EtO mass flow rates. ESCI also used a standard Pitot tube constructed in accordance with Method 2C to measure velocity at a single point in the duct during the test runs to verify that gas flow rate remained steady during tests.

### US EPA Method 3: Gas Analysis for the Determination of Dry Molecular Weight (40 CFR 60 Appendix A)

The Construction permit at 6(b) specifies testing using Method 3A or 3B (for calculating the dry molecular weight of the duct gases based on measurement of the duct gas oxygen and carbon dioxide concentrations). In accordance with Method 2, Section 8.6 and the approved Test Protocol, a dry molecular weight of 29.0 was assumed instead of by calculation. This is in accordance with Method 2 and is allowed by Method 3 because the process does not involve combustion and emits essentially ambient air.

### US EPA Method 4: Determination of Moisture Content in Stack Gases (40 CFR 60 Appendix A)

The moisture concentrations in the duct gases were calculated assuming saturated conditions based on the measured gas temperature, duct static pressure and barometric pressure, in accordance with Method 4(16.4). For calculations pertaining to this method, see Appendix D.

- Barometric pressure was determined using local meteorological data from the time and date of the actual testing. See Appendix F.
- Duct static pressure was determined using an inclined oil manometer.
- Duct gas temperature was determined using from a type K thermocouple and thermometer.

### US EPA Method 18: Measurement of Gaseous Organic Compound Emissions by Gas Chromatography

The major organic component of the gas mixture, EtO is separated by gas chromatography (GC). Measurement of EtO concentrations across the inlet/outlet ducts are expected to be uniform due to extensive air mixing throughout the emission control system. During backvent operations, constituents of the streams entering and exiting the AAT System were analyzed at a single point by an SRI, Model 8610, portable GC, equipped with the following: dual, heated sample loops and injectors; dual columns; and dual detectors. A flame ionization detector (FID) was used to quantify inlet EtO emissions, and photoionization detector (PID) was used to quantify low-level EtO emissions at the emission control system outlet. The PID was equipped with a 11.7eV lamp. For chromatographic data associated with the use of this method, see Appendix E. The sample transport system is described in Section 5.4 of this report.

Samples were continuously extracted and analyzed at approximately one- to two-minute intervals, for a total of 12 to 13 samples, during each 15-minute test run.

## **5.2 VOLUMETRIC FLOW MEASUREMENT**

Exhaust gas flow at the inlet and outlet of the AAT scrubber was determined by Method 2, using an S-type pitot tube and an inclined-oil manometer. Sampling ports were located in accordance with Method 1. The test ports were located far enough from any flow disturbances and velocity was measured at multiple points within the duct cross-section to permit accurate flow measurement. Equal-area traverse points for pre-test velocity traverses were selected in accordance with Method 1. Confirmation of the absence of cyclonic flow occurred prior to the commencement of the three test runs. Please see Appendices B and F for additional Method 1 related information.

Because of the short duration of the backvent operation, traversing the entire stack during each minute of test run was infeasible. With approval of IEPA and US EPA, an average differential pressure point was determined before the test, and that parameter was used to confirm flow during each minute while concentration samples were collected. Please see Appendix F for tables of this information collected in the field.

Temperature measurements were obtained from a type K thermocouple (FLIR EA10) and thermometer attached to the sampling probe. Exhaust gas composition was assumed to be air saturated with water vapor.

## **5.3 CONTROL EFFICIENCY AND MASS EMISSIONS MEASUREMENT**

During backvent operations, constituents of the streams entering and exiting the AAT System were analyzed by an SRI, Model 8610, portable gas chromatograph (GC), equipped with the following: dual, heated sample loops and injectors; dual columns; and dual detectors. A flame ionization detector (FID) was used to quantify inlet EtO emissions, and photoionization detector (PID) was used to quantify low-level EtO emissions at the emission control system outlet. The PID was equipped with an 11.7eV lamp. The mass of EtO in the inlet and outlet streams were determined using equation shown below in Section 5.9. EtO mass control efficiency during the backvent process was calculated by comparing the mass of EtO

vented to the system inlet to the mass of EtO vented from the system outlet. See equation shown in Section 5.9.

#### **5.4 SAMPLE TRANSPORT**

The Willowbrook I facility utilizes a dual stage AAT system equipped with a 15,500 cfm rated blower system that serves to quickly draw process emissions from the sources through the control system. The AAT Scrubber system efficiency operates at a very high level in large part due to the use of sulfuric acid in the scrubber liquor, which lowers the pH of the solution and acts as a catalyst - increasing the speed of the hydrolysis of ethylene oxide to ethylene glycol.

The gas sample was continuously pumped to the GC at approximately 1000 cubic centimeters per minute (cc/min) from the sample probe through two 100-foot lengths of heated and insulated 3/8" Teflon® sample line (.030 wall), each with an interior volume of approximately 1535 cubic centimeters. The source gas was pumped to the GC with a response time of approximately 1.5 seconds. See Appendix H for sample line volume and residence time calculations.

The lines were heated to  $\geq 110$  °C. Temperature of the heated lines was monitored before, during and after each trial run via observing the temperature on the heated lines temperature controller. See Appendix A for this data. The sample probe was constructed of stainless steel tubing and was not heated.

At the inlet of the Safe Cell System, the sampling ports were located in the duct immediately upstream of the packed tower scrubber. At the outlet of the AAT System, sampling ports were located in the exhaust stack downstream of the dry bed reactors. See Appendix B for sampling port location information.

#### **5.5 GC INJECTION**

Source-gas samples were then injected into the GC which was equipped with two heated sampling loops, each containing a volume of approximately 2 cubic centimeters (cc) and maintained at 100 degrees Celsius (°C). Injections occurred at approximately one to two-minute intervals during backvent testing. Helium was the carrier gas for both the FID and the PID.

## **5.6 GC CONDITIONS**

The packed columns for the GC were both operated at 90 °C. The columns were stainless steel, 6 feet long, 0.125 inch outer diameter, packed with 1 percent SP-1000 on 60/80 mesh Carbopack B.

During the analysis, the FID was operated at 250 °C. The support gases for the FID were hydrogen (99.995% pure) and air (99.9999% pure). Any unused sample gas was vented from the GC system back to the inlet of the control device being tested.

## 5.7 CALIBRATION STANDARDS

The FID was calibrated for mid-range part-per-million-by-volume (ppmv) level analysis using gas proportions similar to the following:

- 1) 1000 ppmv EtO, balance nitrogen \*\*\*
- 2) 100 ppmv EtO, balance nitrogen
- 3) 50 ppmv EtO, balance nitrogen (audit gas)
- 4) 10 ppmv EtO, balance nitrogen
- 5) 1 ppmv EtO, balance nitrogen

\*\*\*Note: Calibrations for this standard were performed following the test to confirm appropriate range of instrument.

The PID was calibrated for low-range ppmv level analyses using gas proportions similar to the following:

- 1) 100 ppmv EtO, balance nitrogen
- 2) 50 ppmv EtO, balance nitrogen (audit gas)
- 3) 10 ppmv EtO, balance nitrogen
- 4) 1 ppmv EtO, balance nitrogen

See Appendix J for calibration gas certifications. Please see Appendix I for triplicate calibration data performed before and after each set of test runs and calibration curves.

As a part of the test's quality assurance, limit of detection and recovery studies were performed. Refer to that section later in the document and Appendices K and I, respectively for further information.

## 5.8 SAMPLING DURATION

Testing was performed in 15-minute increments in conjunction with normal production operations, for each of the three test runs while chamber backvents were operating.



## 5.9 SAMPLE CALCULATIONS

### Method 1

Equivalent diameter was calculated as follows:

$$D_e = \frac{2(L)(W)}{L + W}$$

Actual diameters of round ducts and equivalent diameters of square and rectangular ducts were used to evaluate whether sufficient distance existed between the sample ports and upstream and downstream flow disturbances. These figures were used in conjunction with Method 1's Table 1.1 and 1.2 to ensure that the minimum number of traverse points required for testing was exceeded.

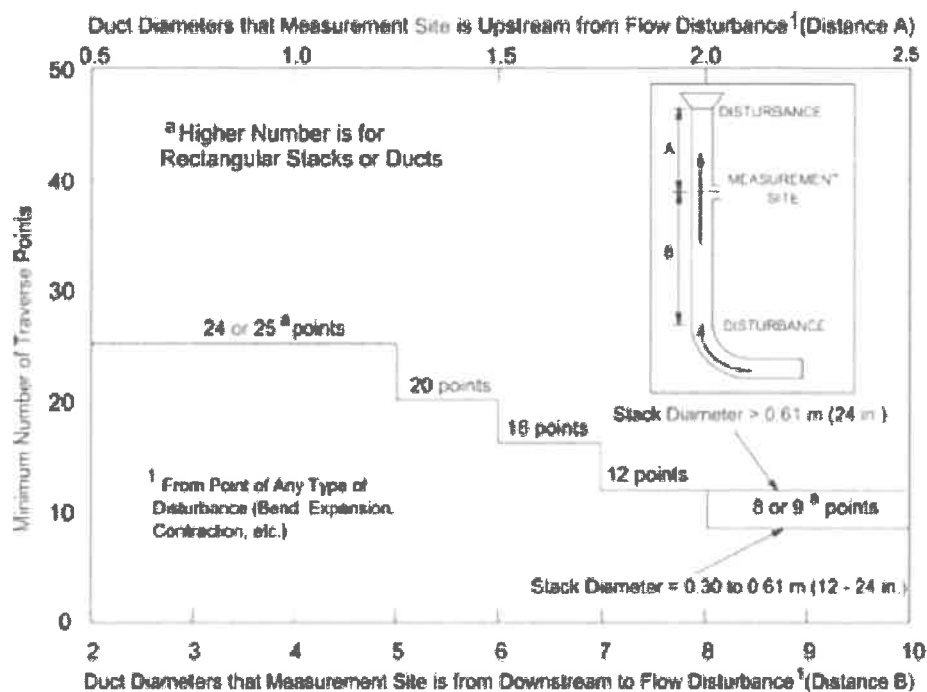


Figure 1-1. Minimum number of traverse points for particulate traverses

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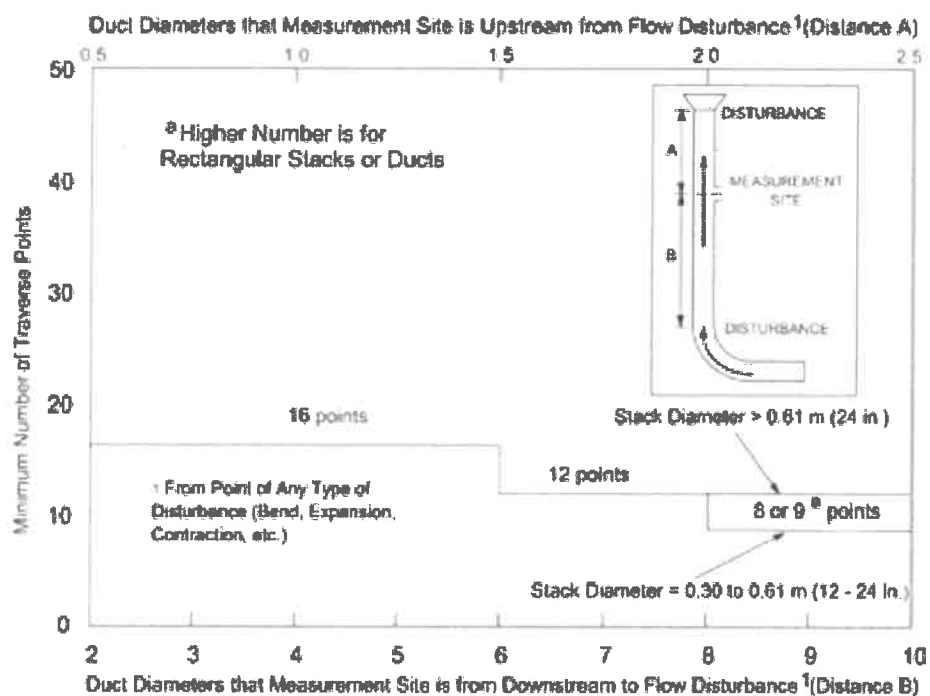


Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses

## Method 2

Stack gas velocity and volumetric flow rate were calculated using equation 2-7 and 2-8 as outlined in Method 2.

Q = Average Stack Gas Dry Volumetric Flow Rate (dscf/min)

$$= 60 (1 - B_{ws}) V_s A \left| \frac{T_{std} P_s}{T_{s(abavg)} P_{std}} \right|$$

$V_s$  = Average Stack Gas Velocity

$$V_s = K_p C_p \left[ \frac{\sum_{i=1}^n \sqrt{\Delta p_i}}{n} \right] \sqrt{\frac{T_{s(abavg)}}{P_s M_s}}$$

Where:

$K_p$  = Velocity equation constant

$$= 85.49 \frac{ft}{sec} \left[ \frac{(lb/lb-mole)(in. Hg)}{(^{\circ}R)(in. H_2O)} \right]^{1/2}$$

$C_p$  = Pitot Tube Coefficient = 0.84 (S-type pitot tube coefficient for geometric calibration)

$\Delta p_i$  = Individual velocity head reading at traverse point "i" (in. Hg)

$n$  = number of traverse points

$T_{s(abavg)}$  = Average absolute stack temperature ( $^{\circ}R$ )

$P_s$  = Absolute stack pressure ( $P_{bar} + P_g$ )

$P_{bar}$  = Barometric pressure at measurement site (in. Hg)

$P_g$  = Stack static pressure (in. Hg)

$M_s$  = Molecular weight of stack gas, wet basis

$$M_s = M_d (1 - B_{ws}) + 18.0 B_{ws}$$

#### Method 4

Moisture content was determined using the calculation for saturation in accordance with Method 4.

$$B_{ws(svp)}(\%) = 100 \left( \frac{10^{\left( 6.691 - \left( \frac{3144}{T_{s(avg)} + 297.66} \right) \right)}}{\left( P_b + \frac{P_{static}}{13.6} \right)} \right)$$

Where:

$B_{ws(svp)}(\%)$  = Saturated moisture concentration (% by volume)

$T_{s(abavg)}$  = Average absolute stack temperature (°F)

$P_b$  = Barometric pressure at measurement site (in. Hg)

$P_{static}$  = Stack static pressure (in. H<sub>2</sub>O)

#### Mass Emission Calculation

Mass emissions of EtO during backvent were calculated using the following equation:

$$W = (Q)(\text{MolWt})(C/10^6)/(\text{MolVol})$$

Where:

$W$  = EtO mass flow rate, pounds per minute

$Q$  = Corrected duct gas volumetric flow rate, dry standard cubic feet per minute at 68 degrees F and 29.92 in. Hg (see calculation under Method 2)

$\text{MolWt}$  = 44.05 pounds EtO per pound mole

$C$  = EtO concentration, parts per million by volume

$10^6$  = Conversion factor, ppmv per "cubic foot per cubic foot"

$\text{MolVol}$  = 385.32 cubic feet per pound mole at 68 degrees F and 29.92 in. Hg

#### Control Efficiency Calculation

Mass control efficiency of EtO during backvent was calculated using the following equation:

$$\text{Efficiency} = (W_i - W_o / W_i)(100)$$

Where:

$W_i$  = Mass flow rate to the control device inlet, pounds per minute, calculated as described above  
where:

$C_i$  = EtO concentration at the control device inlet, ppm

$Q_i$  = Duct gas volumetric flow rate at the control device inlet, dry standard cubic feet per minute

$W_o$  = Mass flow rate from the control device outlet, pounds per minute calculated as described above  
where:

$C_o$  = EtO concentration at the control device outlet

$Q_o$  = Duct gas volumetric flow rate at the control device outlet, dry standard cubic feet per minute

### Correction to Dry Basis

*Dry basis concentration = (wet basis concentration) / (1-w)*

where:

$w$  = fraction of emitted exhaust gas, by volume, which is water vapor.

Results of the control-efficiency testing are presented in Section 8.0 and in Table 1 and 2.

## 6.0 TEST SCENARIO

Backvent testing was performed during normal process load conditions, with freshly sterilized product in the sterilization chambers. Three test runs were conducted in series to verify the performance of the emission-control system.

Sterigenics scheduled three chambers to end the sterilization cycle to allow for the three test runs to run consecutively. The general testing sequence was as follows:

Timing	Task	Method
Prior to test	Sample locations established	Method 1
Prior to test	Sample traverse locations established	Method 1
One time prior to each set of runs	3-point calibration performed in triplicate.	Method 18
One time prior to each set of runs	Confirm absence of cyclonic flow	Method 1
One time prior to each set of runs	Collect AAT system scrubber liquor pH, tank level, and glycol % information. Note levels present from aeration.	N/A
One time prior to each set of runs	Flow traverse of inlet and outlet conducted to establish flow rate and measurement centroid	Method 2
Prior to each test run	Note temperature reading of heated lines	N/A
Over test duration	Chamber door opened approximately 12 inches, actuator switch activates backvent	N/A
Beginning of each run	First sample initiated	Method 18
Over test duration	Samples at inlet and outlet taken approximately every 1-minute for a total of 15-minutes	Method 18
Over test duration	Flow monitoring sampled approximately every 1-minute.	Method 2
Mid-Test	Note temperature reading of heated lines	Method 18
After each test run	Collect cycle number and ending backvent EtO concentration in chamber head space are noted	N/A
After each test run	Note temperature reading of heated lines	Method 18
After each test run	Conduct recovery study	Method 18
After conclusion of each set of test runs	Perform post calibration checks	Method 18
After conclusion of each set of test runs	Collect AAT system scrubber liquor pH, tank level, and glycol %.	N/A
One time following each set of runs	Obtain meteorological data for sampling time	N/A
At least once during two test days for WB I and WB II	Perform Limit of Detection Study	Method 18

## **7.0 QA/QC**

### **7.1 FIELD TESTING QUALITY ASSURANCE**

At the beginning of the test, the sampling system was leak checked at a vacuum of 15 inches of mercury. The sampling system was considered leak free when the flow indicated by the rotameters fell to zero.

At the beginning of the test, a system blank was analyzed to ensure that the sampling system was free of EtO. Ambient air was introduced at the end of the heated sampling line and drawn through the sampling system line to the GC for analysis. The resulting chromatogram also provided a background level for non-EtO components (i.e. ambient air, carbon dioxide, water vapor) which are present in the source gas stream due to the ambient dilution air which is drawn into the emission-control device, and due to the destruction of EtO by the emission-control device which produces carbon dioxide and water vapor. This chromatogram, designated ambient background, is included with the calibration data in Appendix I.

A recovery study was also performed in accordance with Section 8.4.1 of Method 18 using 10 ppm and 100 ppm EtO calibration gas. The 100 ppm calibration gas was drawn through the heated sample line used at the control device inlet, and the 10 ppm calibration gas was drawn through the heated sample line used at the control device outlet. The calibration procedure was repeated in this manner, and it was verified that the analyzer response was within 10% of the calibration gas concentration sampled. See calibration data in Appendix I for further information regarding the recovery study.

### **7.2 CALIBRATION PROCEDURES**

The GC system was calibrated at the beginning and conclusion of each day's testing. Using the Peaksimple II analytical software, a calibration curve was constructed for each detector. Calibration data can be found in Appendix I.

A seven-point Method Detection Limit (MDL) or Limit of Detection (LOD) study was performed prior to testing using procedures described in Section 15.0 of US EPA Method 301 (40 CFR 63 Appendix A) and in 40 CFR 136 Appendix B. The study was recommended by OAQPS and accepted by IEPA. The LOD for this test was determined to be 0.10 ppm. A recovery study was also performed in accordance with Section 8.4.1 of Method 18 using 10 ppm and 100 ppm EtO calibration gas. The 100 ppm calibration gas was

drawn through the heated sample line used at the control device inlet, and the 10 ppm calibration gas was drawn through the heated sample line used at the control device outlet. The calibration procedure was repeated in this manner, and it was verified that the analyzer response was within 10% of the calibration gas concentration sampled. Results of the LOD study are presented in Appendix K. Results of the recovery study are presented in Appendix I.

All calibration gases and support gases used were of the highest purity and quality available. A copy of the laboratory certification for each calibration gas is attached as Appendix J.



## 8.0 TEST RESULTS

The AAT Safe Cell System demonstrated an EtO control efficiency of greater than 99.61 percent. In accordance with various state and federal requirements, this control equipment must have an EtO control efficiency of 99 percent or more. The AAT Safe Cell System has met this requirement.

The test results are summarized in Tables 1 and 2. These tables include results for EtO control efficiency of the emission-control device. Sample calculations related to destruction efficiency and other calculations can be found in Section 5.9.

## TABLES 1 AND 2

**TABLE 1**  
**ETHYLENE OXIDE CONTROL EFFICIENCY SUMMARY – BACKVENT**  
**FOR STERIGENICS - WILLOWBROOK, ILLINOIS (PLANT 1)**  
**ON SEPTEMBER 21, 2018**

Test Run	Inlet Average Concentration (ppm)	Inlet Average Mass Flow rate (lb/min)	Outlet Average Concentration (ppm) <sup>1</sup>	Outlet Average Mass Flow rate (lb/min) ≤	Control Efficiency ≥
1	70.86	0.07984	ND	0.00012	99.6192%
2	30.21	0.03401	ND	0.00012	99.6410%
3	25.40	0.02853	ND	0.00012	99.5795%

**Control Efficiency ≥ 99.6132%**

$$\text{Efficiency} = (\text{MassFlowin} - \text{MassFlowout} / \text{MassFlowin})(100)$$

$$\text{Mass Flow (lb/min)} = (\text{VolFlow})(\text{MolWt})(C / 10^6) / (\text{MolVol})$$

**MW EtO = 44.05**

**MolVol = 385.32**

**C = Dry Concentration**

[1] ND = Non Detect. Detection limit of the GC was determined to be 0.10 ppm.

	INLET		OUTLET	
	Average Temperature (°F)	Moisture Content (%)	Average Temperature (°F)	Moisture Content (%)
Run 1	103.8	7.4862	103.8	7.4767
Run 2	104.1	7.5373	104.1	7.5277
Run3	104.9	7.7264	104.9	7.7166

**TABLE 2 - ETHYLENE OXIDE CONTROL EFFICIENCY – BACKVENT  
FOR STERIGENICS - WILLOWBROOK, ILLINOIS (PLANT 1)  
ON SEPTEMBER 21, 2018**

Run #	Time	INLET ETO				Wet Concentration (PPM) <sup>1,2</sup>	OUTLET ETO			Control Efficiency <sup>4</sup> ≥
		Wet Concentration (PPM) <sup>1</sup>	Dry Concentration (PPM) <sup>1</sup>	Dry Volumetric Flow	Mass Flow <sup>3</sup> (lb/min)		Dry Concentration (PPM) <sup>1,2</sup>	Dry Volumetric Flow	Mass Flow <sup>3</sup> (lb/min) ≤	
1	914	11.5	12.43058	9856.0	0.01401	ND	ND	9667.3	0.0001194	99.1472%
1	915	542	585.85843	9856.0	0.66011	ND	ND	9667.3	0.0001194	99.9819%
1	916	38.9	42.04777	9856.0	0.04738	ND	ND	9667.3	0.0001194	99.7479%
1	917	34.5	37.29173	9856.0	0.04202	ND	ND	9667.3	0.0001194	99.7157%
1	918	27.6	29.83338	9856.0	0.03361	ND	ND	9667.3	0.0001194	99.6447%
1	919	26.8	28.96865	9856.0	0.03264	ND	ND	9667.3	0.0001194	99.6340%
1	920	27	29.18483	9856.0	0.03288	ND	ND	9667.3	0.0001194	99.6368%
1	921	23.1	24.96924	9856.0	0.02813	ND	ND	9667.3	0.0001194	99.5754%
1	923	26.4	28.53628	9856.0	0.03215	ND	ND	9667.3	0.0001194	99.6285%
1	924	24	25.94207	9856.0	0.02923	ND	ND	9667.3	0.0001194	99.5914%
1	925	23.7	25.61779	9856.0	0.02886	ND	ND	9667.3	0.0001194	99.5862%
1	926	23.5	25.40161	9856.0	0.02862	ND	ND	9667.3	0.0001194	99.5827%
1	927	23.2	25.07733	9856.0	0.02826	ND	ND	9667.3	0.0001194	99.5773%
2	931	24	25.95640	9849.5	0.02923	ND	ND	9661.0	0.0001194	99.5914%
2	932	22.5	24.33413	9849.5	0.02740	ND	ND	9661.0	0.0001194	99.5641%
2	933	42.3	45.74816	9849.5	0.05151	ND	ND	9661.0	0.0001194	99.7681%
2	934	31.3	33.85148	9849.5	0.03812	ND	ND	9661.0	0.0001194	99.6867%
2	935	28.8	31.14768	9849.5	0.03507	ND	ND	9661.0	0.0001194	99.6595%
2	936	28.7	31.03953	9849.5	0.03495	ND	ND	9661.0	0.0001194	99.6583%
2	937	28.5	30.82323	9849.5	0.03471	ND	ND	9661.0	0.0001194	99.6559%
2	939	26.7	28.87650	9849.5	0.03252	ND	ND	9661.0	0.0001194	99.6327%
2	940	26.8	28.98465	9849.5	0.03264	ND	ND	9661.0	0.0001194	99.6340%
2	941	26.4	28.55204	9849.5	0.03215	ND	ND	9661.0	0.0001194	99.6285%
2	942	26.9	29.09280	9849.5	0.03276	ND	ND	9661.0	0.0001194	99.6354%
2	943	25	27.03792	9849.5	0.03044	ND	ND	9661.0	0.0001194	99.6077%
2	944	25.2	27.25422	9849.5	0.03069	ND	ND	9661.0	0.0001194	99.6108%
3	953	23.1	25.03424	9825.7	0.02812	ND	ND	9637.6	0.0001194	99.5754%
3	954	22.8	24.70912	9825.7	0.02776	ND	ND	9637.6	0.0001194	99.5698%
3	955	27.8	30.12779	9825.7	0.03384	ND	ND	9637.6	0.0001194	99.6472%
3	956	26	28.17707	9825.7	0.03165	ND	ND	9637.6	0.0001194	99.6228%
3	957	23.8	25.79286	9825.7	0.02897	ND	ND	9637.6	0.0001194	99.5879%
3	958	23	24.92587	9825.7	0.02800	ND	ND	9637.6	0.0001194	99.5736%
3	1000	22.3	24.16726	9825.7	0.02715	ND	ND	9637.6	0.0001194	99.5602%
3	1001	22.8	24.70912	9825.7	0.02776	ND	ND	9637.6	0.0001194	99.5698%
3	1002	22.8	24.70912	9825.7	0.02776	ND	ND	9637.6	0.0001194	99.5698%
3	1003	23.4	25.35936	9825.7	0.02849	ND	ND	9637.6	0.0001194	99.5809%
3	1004	21.7	23.51702	9825.7	0.02642	ND	ND	9637.6	0.0001194	99.5480%
3	1006	21.7	23.51702	9825.7	0.02642	ND	ND	9637.6	0.0001194	99.5480%

**Notes**

- [1] PPM = parts per million by volume  
 [2] ND = Non Detect. Detection limit of the GC was determined to be 0.10 ppm.  
 [3] See Table 1 for Mass Flow Calculation  
 [4] See Table 1 for Control efficiency calculation

$$\text{Efficiency} = (\text{MassFlowin} - \text{MassFlowout} / \text{MassFlowin})(100)$$

$$(\text{lb/min}) = (\text{VolFlow})(\text{MolWt})(\text{C} / 10^6) / (\text{MolVol})$$

MW EtO = 44.05  
 MolVol = 385.32

## APPENDICES

**APPENDIX A**  
**Process Parameter Logs**

PROCESS PARAMETER LOG FOR EACH TRIAL

DATE: 21 SEP 2018

SITE AAT TESTED (circle one) Willowbrook I Willowbrook II

Chamber Backvent Tested:	A	
Chamber Running Cycle Number:	183 6 pellet chamber - w/6 pellets	
Parameter	START (Data and Time)	FINISH (Data and Time)
Backvent Opening Time	9:12 AM	9:27 AM
Levels From Aeration	11 ppm 9:09 AM 10.9 ppm 9:10 AM	not recorded
Ending Chamber EO Concentration	7020 ppm EO	

	Beginning (Time)	Middle (Time)	End (Time)
Heated Lines Temp Check Include Temp Units	230 F / 230 F 9:10 AM	230 F / 230 F 9:17 AM	230 F / 230 F 9:27 AM

# PROCESS PARAMETER LOG FOR EACH TRIAL

DATE: 21 SEP 2018

SITE AAT TESTED (circle one): Willowbrook I Willowbrook II

Chamber Backvent Tested:	3 6' pallet chamber w/ 6 pallets	
Chamber Running Cycle Number:	169	
Parameter	START (Data and Time)	FINISH (Data and Time)
Backvent Opening Time	9:30 am	9:45 am
Levels From Aeration	not recorded	not recorded
Ending Chamber EO Concentration	2760 ppm EO	

	Beginning (Time)	Middle (Time)	End (Time)
Heated Lines Temp Check Include Temp Units	230 F / 230 F	230 F / 230 F	230 F / 230 F
	9:36 AM	9:40 AM	9:45 AM



**PROCESS PARAMETER LOG FOR EACH TRIAL**

DATE: 21 SEP 2018

SITE AAT TESTED (circle one): Willowbrook I Willowbrook II

Chamber Backvent Tested:	10 13 pallet chamber w/ 12 pallets	
Chamber Running Cycle Number:	510	
Parameter	START (Data and Time)	FINISH (Data and Time)
Backvent Opening Time	9:52am	10:07am
Levels From Aeration	not recorded	not recorded
Ending Chamber EO Concentration	0 ppm EO	

	Beginning (Time)	Middle (Time)	End (Time)
Heated Lines Temp Check Include Temp Units	230 F / 230 F	230 F / 230 F	230 F / 230 F
	9:55 AM	9:59 AM	10:07 AM

PROCESS PARAMETER LOG FOR EACH SET OF TRIALS

Circle One: Willowbrook 1 AAT Willowbrook 2 AAT

Parameter	BEFORE (Time)	AFTER (Time)
AAT Tank Level (inches)	151" 8:12 AM	144" 10:20 AM
AAT Liquor pH	0.87 8:12 AM	0.87 10:20 AM
AAT Liquor Glycol %	36.2% 8:12 AM	36.4 10:20 AM

Samples collected by:

Signature:

DATE:

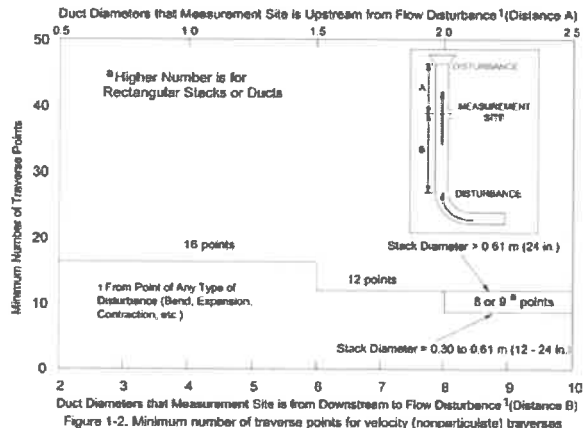
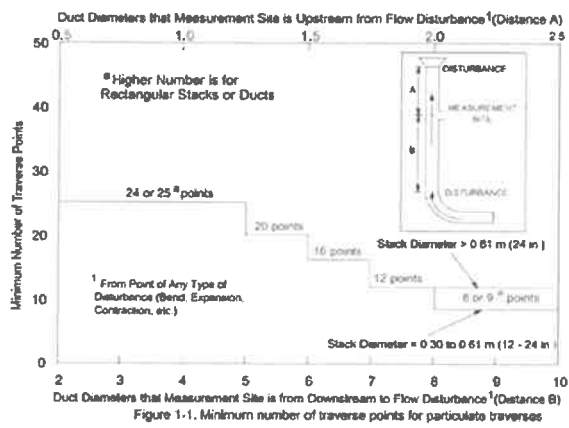
21 SEP 2018

PLEASE ATTACH TODAY'S METEOROLOGICAL DATA TO THESE TEST RECORDS

## **APPENDIX B**

### **Method 1 Calculation**

WB Sample Port Locations	Duct Size/Configuration	Length (Diameter)	Width	Diameter (Eq. Diameter)		Distance from/to Disturbance	Diameters from/to Disturbance	2D or greater downstream?	0.5D or greater upstream?
WB I Inlet	36" round	36		36	Downstream	78	2.2	YES	
				36	Upstream	44	1.2		YES
WB I Outlet	30" x 20" rectangular	30	20	24	Downstream	60	2.5	YES	
				24	Upstream	84	3.5		YES
WB II Inlet	28" round	28		28	Downstream	108	3.9	YES	
				28	Upstream	96	3.4		YES
WB II Outlet	28" square	28	28	28	Downstream	56	2.0	YES	
				28	Upstream	170	6.1		YES



$$D_s = \frac{2(L)(W)}{L + W}$$

**Willowbrook 1 AAT Inlet Duct Sampling Location**

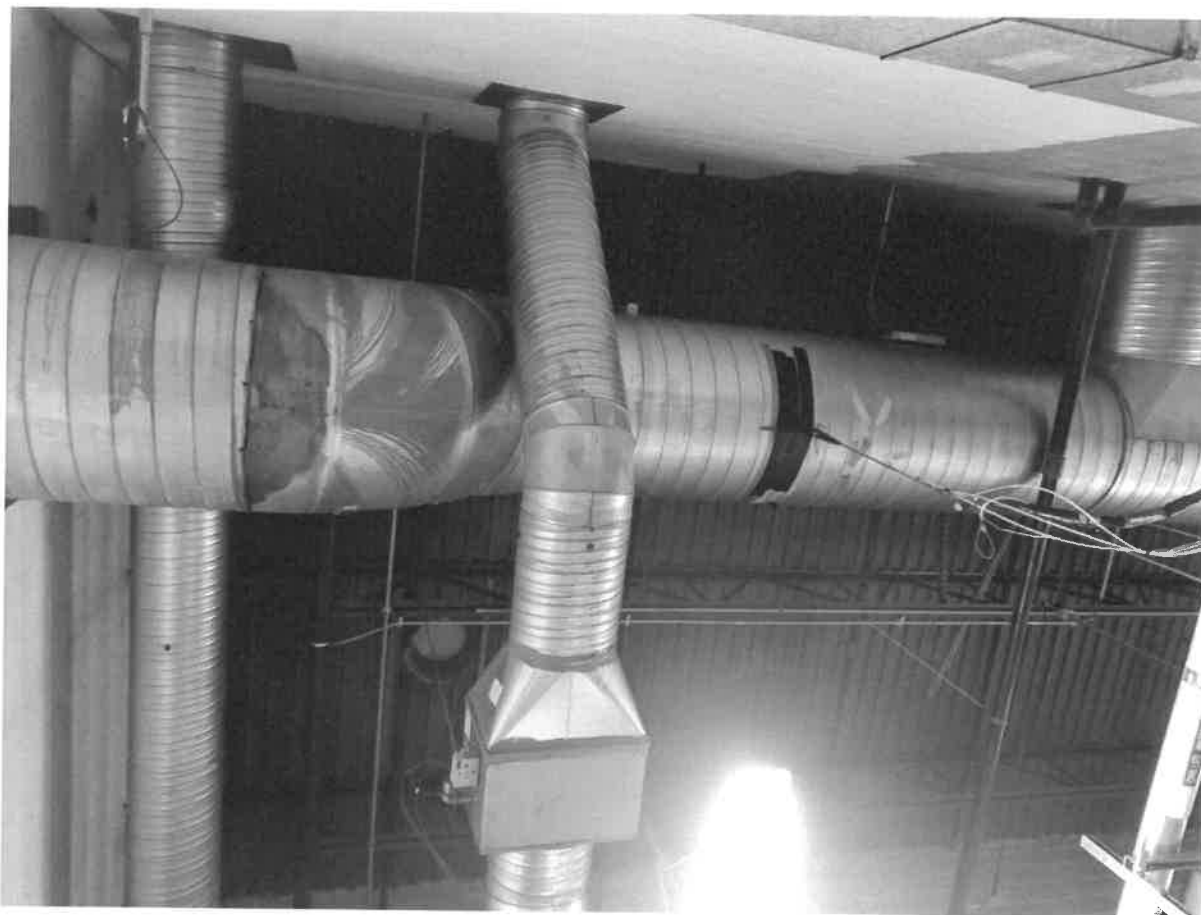


Photo Description – Photo taken in WB1 Chamber C Room, looking towards roof near room entrance. North and AAT control device is to the left.

### Willowbrook I Inlet Duct Sampling Duct Location Diagram

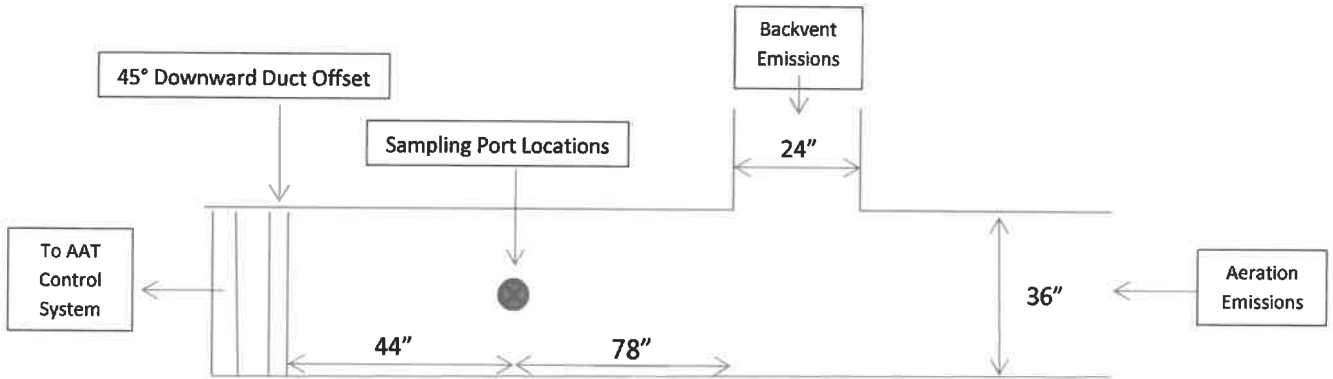


Diagram Description – Diagram depicts inlet duct configuration seen in photo, looking towards roof. All ducts are circular, with given diameters. 44" and 78" are measurements to nearest disturbances in the duct from sample port location.

Sampling port depicted is facing Chamber C Room floor. An additional port will be located on the duct 90° from depicted port.

**Willowbrook 1 AAT Outlet Duct Sampling Location**



Photo Description – Photo taken in WB1 AAT Drybed Room, looking Southeast. Duct is rectangular until it transitions near the roofline.

### Willowbrook I Outlet Sampling Duct Location Diagram

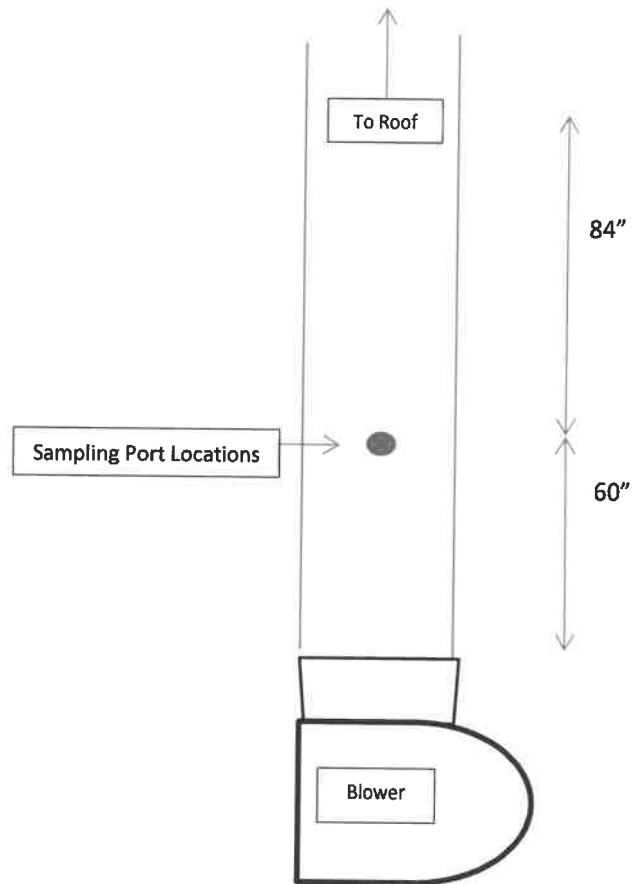


Diagram Description – Diagram depicts outlet duct sampling configuration in AAT Drybed Room seen in photo, with a slightly more perpendicular view to the duct, towards the south. The main run of ducting where the samples will be obtained is a 30" x 20" rectangular duct. 84" and 60" are measurements to nearest duct disturbances.



## **APPENDIX C**

### **Method 2 Calculation**

# ECSi, Inc.

## Volumetric Flow Calculation - AAT Inlet

**Sterigenics US, LLC - Willowbrook, IL (Plant 1)**

**9/20/2018**

### Data from Traverse Table

<b>Average SQRT(<math>\Delta p</math>)</b>	0.4644	from Traverse Table
<b>Temp</b>	103.0	°F
	563	°R
<b>Moisture Content</b>	7.30%	
<b>Ms</b>	28.20	molecular weight of stack gas
<b>Pb</b>	28.95	Barometric pressure (in Hg)
<b>Pg</b>	-0.25	Stack static pressure (in H2O)
<b>Ps</b>	28.932	Absolute stack pressure

### Constants

<b>MW dry =</b>	29.00	
<b>stack diameter =</b>	36	in.
<b>stack area =</b>	7.07	sq. ft.
<b>Tstd =</b>	528	
<b>Pstd =</b>	29.92	
<b>Cp =</b>	0.84	
<b>Kp =</b>	85.49	

**Stack Velocity (Vs) =**                      27.7        ft/sec

$$V_s = K_p C_p \left[ \frac{\sum_{i=1}^n \sqrt{\Delta P_i}}{n} \right] \sqrt{\frac{T_{s(average)}}{P_s M_s}}$$

**Stack Flow (inlet)=**                      11749        acf/min

$$Q_{actual} = 60 \cdot V_s \cdot A_s$$

**Stack Flow (inlet) =**                      9877        dscfm

$$Q = 60 (1 - B_{ws}) V_s A \left| \frac{T_{std} P_s}{T_{s(average)} P_{std}} \right|$$

# ECSi, Inc.

## Volumetric Flow Calculation - AAT Outlet

Sterigenics, Inc. - Willowbrook, IL (Plant 1)

9/20/2018

### Data from Traverse Table

Average SQRT( $\Delta p$ )	0.7718	from Traverse Table
Temp	107.3	°F
	567	°R
Moisture Content	8.20%	
Ms	28.10	molecular weight of stack gas
Pb	28.95	Barometric pressure
Pg	0.25	Stack static pressure
Ps	28.97	Absolute stack pressure

### Constants

MW dry =	29.00	
stack dimensions =	20x30	in.
stack area =	4.17	sq. ft.
Tstd =	528	
Pstd =	29.92	
Cp =	0.84	
Kp =	85.49	

Stack Velocity (Vs) = 46.3 ft/sec

$$V_s = K_p C_p \left[ \frac{\sum_{i=1}^n \sqrt{\Delta P_i}}{n} \right] \sqrt{\frac{T_s(abavg)}{P_s M_s}}$$

Stack Flow (outlet)= 11568 acf/min

$$Q_{actual} = 60 * V_s * A_s$$

Stack Flow (outlet) = 9570 dscfm

$$Q = 60 (1 - B_{ws}) V_s A \left| \frac{T_{std} P_s}{T_s(abavg) P_{std}} \right|$$

# ECSI, INC. - VELOCITY TRAVERSE DATA

Client: Sterigenics

Run #: 1

Date: 9/21/2018

Port Sketch:

Location: Willowbrook - Plant 1

Probe Type: S

Baro Press: 28.95

Source: AAT Safe Cell System Inlet

Stack I.D.: 36 in.



Port 1										Port 2									
Inches From Port	Point#	Delta P				Stack Temp (F)	Cyclonic Angle	Point#	Delta P				Stack Temp (F)	Cyclonic Angle					
		Low	High	Average	Sq Root				Low	High	Average	Sq Root							
0.7	1	0.25	0.25	0.25	0.5000	101	1.5	1	0.21	0.21	0.21	0.4583	103	5.0					
2.4	2	0.15	0.15	0.15	0.3873	101	5.6	2	0.22	0.22	0.22	0.4690	103	4.6					
4.2	3	0.18	0.18	0.18	0.4243	102	2.0	3	0.21	0.21	0.21	0.4583	103	3.6					
6.3	4	0.2	0.2	0.2	0.4472	102	1.8	4	0.25	0.25	0.25	0.5000	103	5.1					
9.0	5	0.21	0.21	0.21	0.4583	102	1.0	5	0.23	0.23	0.23	0.4796	103	3.0					
12.9	6	0.25	0.25	0.25	0.5000	103	0.5	6	0.25	0.25	0.25	0.5000	103	2.6					
23.1	7	0.21	0.21	0.21	0.4583	104	1.0	7	0.16	0.16	0.16	0.4000	103	8.8					
27.0	8	0.23	0.23	0.23	0.4796	104	1.4	8	0.19	0.19	0.19	0.4359	103	6.3					
29.7	9	0.19	0.25	0.22	0.4690	104	2.4	9	0.24	0.24	0.24	0.4899	103	4.1					
31.8	10	0.19	0.19	0.19	0.4359	104	0.5	10	0.22	0.22	0.22	0.4690	103	2.2					
33.6	11	0.26	0.26	0.26	0.5099	105	1.5	11	0.26	0.26	0.26	0.5099	102	2.8					
35.3	12	0.19	0.19	0.19	0.4359	105	1.8	12	0.22	0.22	0.22	0.4690	103	2.1					
	13							13											
	14							14											
	15							15											
	16							16											
	17							17											
	18							18											
	19							19											
	20							20											
	21							21											
	22							22											
	23							23											
	24							24											
Average Values:										0.2167	0.4644	103.0	3.0						

# ECSI, INC. - VELOCITY TRAVERSE DATA

**Client: Sterigenics**

Run #:

Date: 9/21/2018

### Port Sketch:

**Location:** Willowbrook - Plant 1

Probe Type: S

Baro Press: 28.95

Source: AAT Safe Cell System Outlet

Stack I.D.: 20x30

## Port 1 & 2

## Part 3 & 4

[illegible]

## APPENDIX D

### Method 4 Calculation

Sterigenics - Willowbrook 1 - AAT Inlet  
9/21/2018

Saturate Moisture Content (%)

$$B_{ws(svp)}(\%) = 100 \left( \frac{10^{\left( 6.691 - \left( \frac{3144}{T_{s(avg)} + 390.86} \right) \right)}}{\left( P_b + \frac{P_{static}}{13.6} \right)} \right)$$

Ts	<u>103</u>	stack temperature (F)
Pb	<u>28.95</u>	barametreric pressure (in Hg)
ps	<u>-0.25</u>	static pressure of stack (in H2O)

Bws(svp) = 7.30 %

Sterigenics - Willowbrook 1 - AAT Outlet  
9/21/2018

Saturate Moisture Content (%)

$$B_{ws(svp)}(\%) = 100 \left( \frac{10^{\left( 6.691 - \left( \frac{3144}{T_{s(avg)} + 390.86} \right) \right)}}{\left( P_b + \frac{P_{static}}{13.6} \right)} \right)$$

Ts	<u>107</u>	stack temperature (F)
Pb	<u>28.95</u>	barametreric pressure (in Hg)
ps	<u>0.25</u>	static pressure of stack (in H2O)

Bws(svp) = 8.20 %

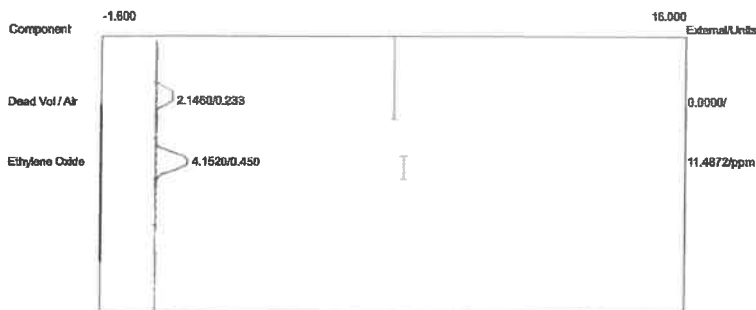


## **APPENDIX E**

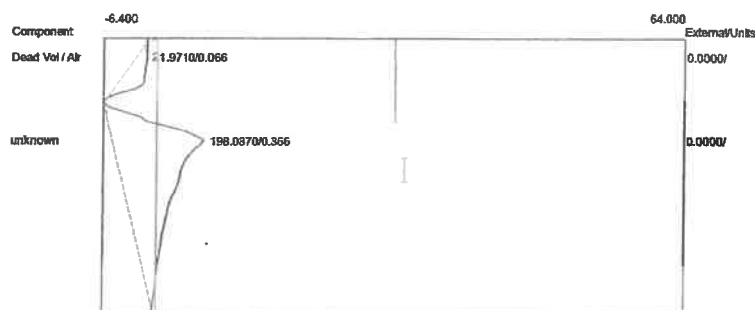
### **Chromatograms - Backvent**

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:14:01  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B01.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:14:01  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B01.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer

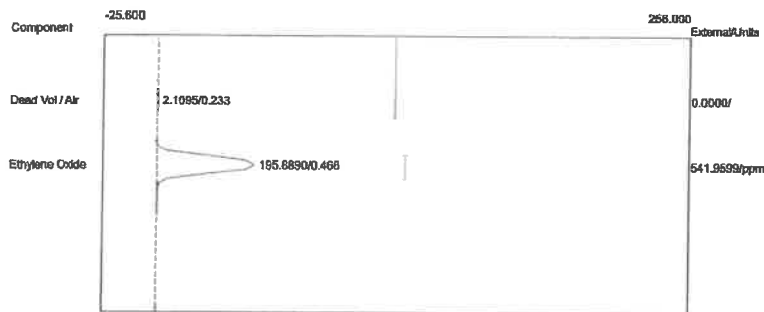


Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.1460	0.0000	
Ethylene Oxide	0.450	4.1520	11.4872	ppm
		6.2980	11.4872	



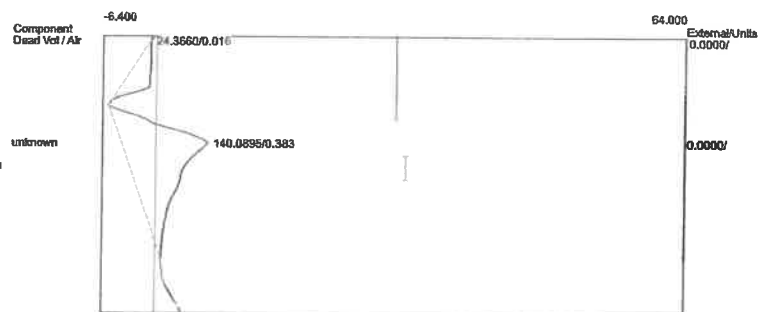
Component	Retention	Area	External	Units
Dead Vol / Air	0.066	21.9710	0.0000	
		21.9710	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:15:04  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B02.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



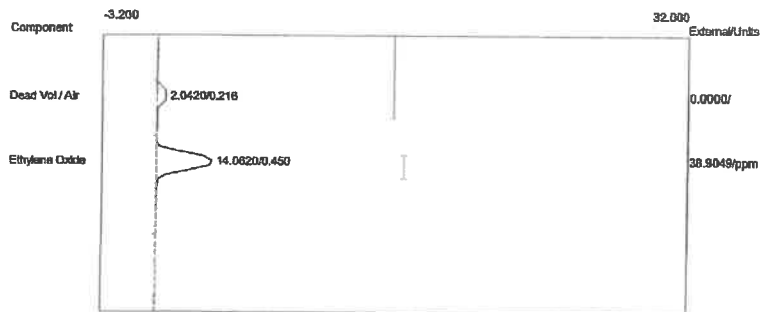
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.1095	0.0000	
Ethylene Oxide	0.466	195.8890	541.9599	ppm
		197.9985	541.9599	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:15:04  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B02.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



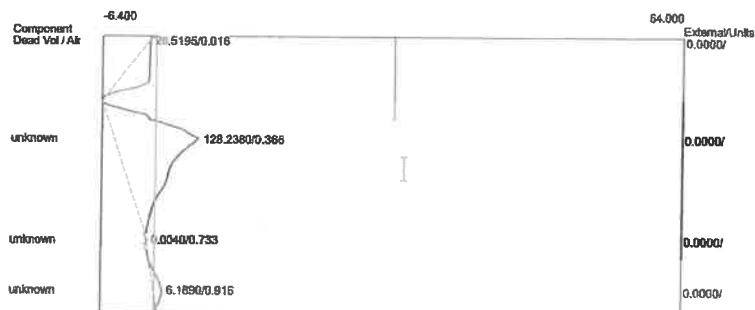
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	24.3660	0.0000	
		24.3660	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:16:13  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B03.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



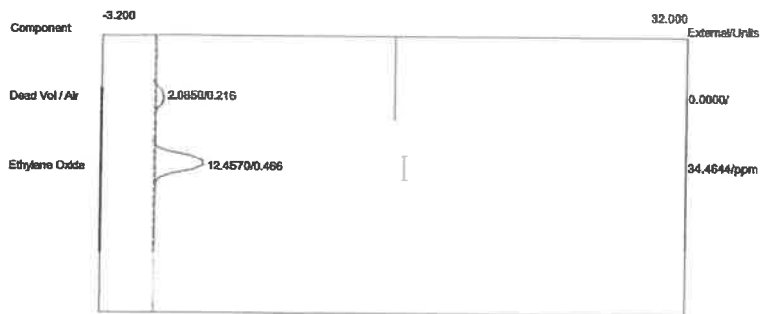
Component	Retention	Area	External	Units
Dead Vol / Air	0.216	2.0420	0.0000	
Ethylene Oxide	0.450	14.0620	38.9049	ppm
		16.1040	38.9049	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:16:13  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B03.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



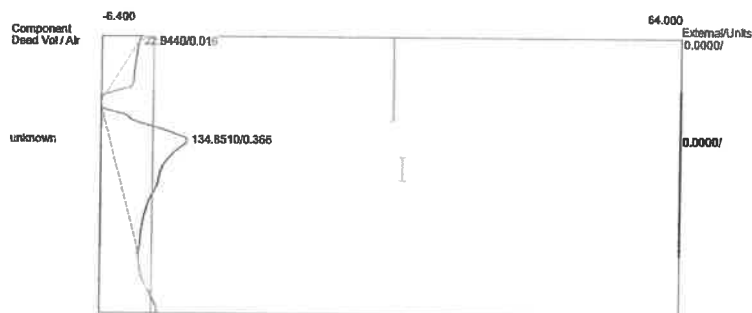
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	26.5195	0.0000	
		26.5195	0.0000	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:17:19  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B04.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



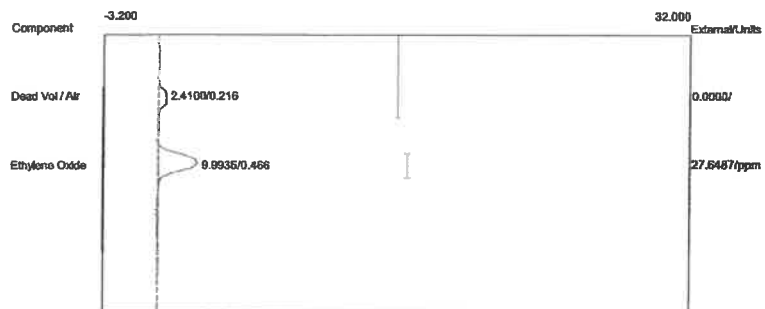
Component	Retention	Area	External	Units
Dead Vol / Air	0.216	2.0850	0.0000	
Ethylene Oxide	0.466	12.4570	34.4644	ppm
		14.5420	34.4644	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:17:19  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B04.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



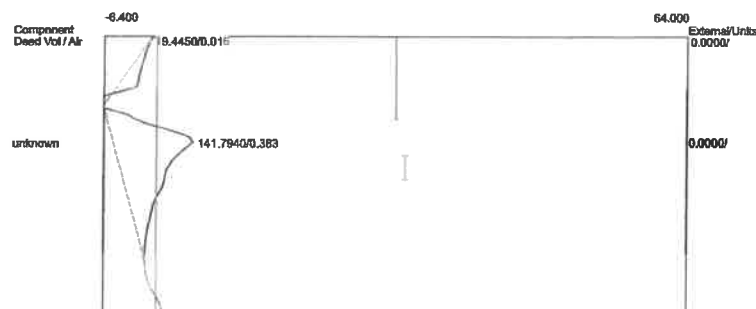
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	22.9440	0.0000	
		22.9440	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:18:24  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B05.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.216	2.4100	0.0000	
Ethylene Oxide	0.466	9.9935	27.6487	ppm
		12.4035	27.6487	

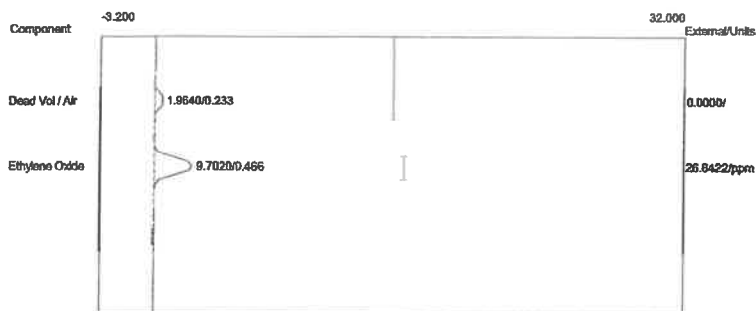
Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:18:24  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B05.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



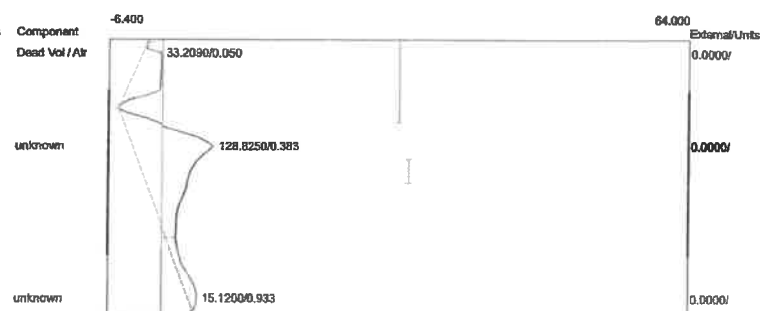
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	19.4450	0.0000	
		19.4450	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:19:34  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tern  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B06.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:19:34  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tern  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B06.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



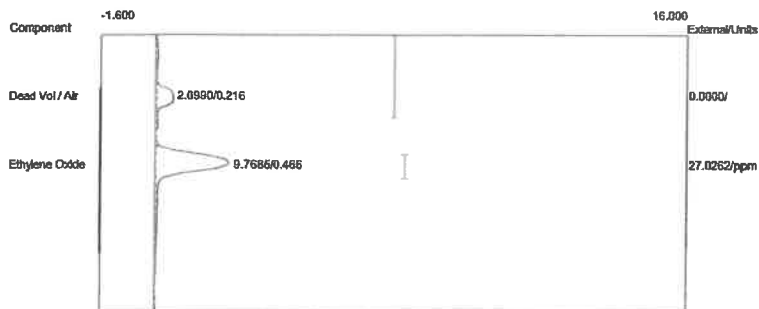
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	1.9640	0.0000	
Ethylene Oxide	0.466	9.7020	26.8422	ppm
		11.6660	26.8422	



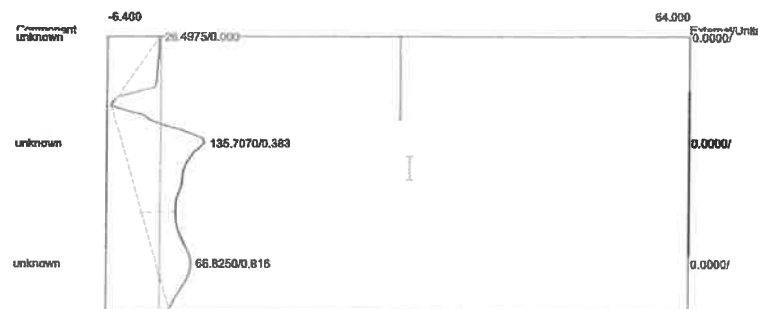
Component	Retention	Area	External	Units
Dead Vol / Air	0.050	33.2090	0.0000	
		33.2090	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:20:50  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B07.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:20:50  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B07.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.216	2.0990	0.0000	
Ethylene Oxide	0.466	9.7685	27.0262	ppm
		11.8675	27.0262	

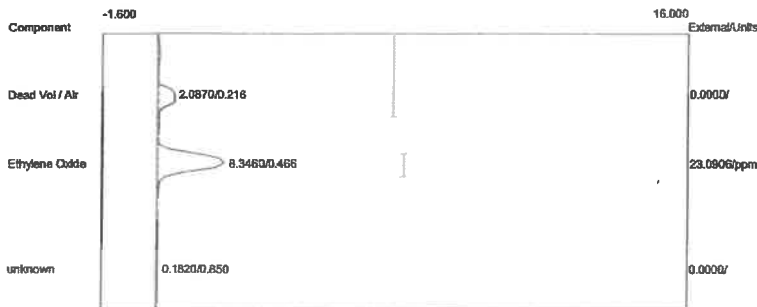


Component	Retention	Area	External	Units
		0.0000	0.0000	

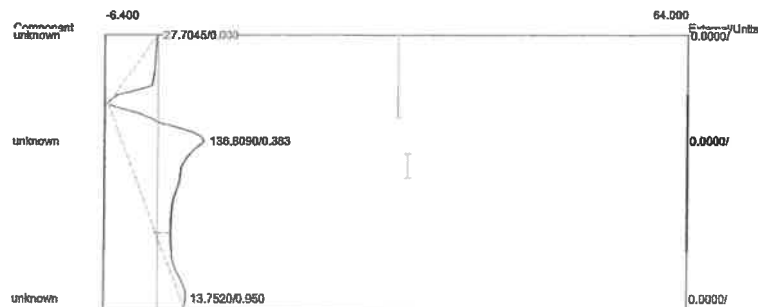


Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:21:58  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B08.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:21:58  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B08.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer

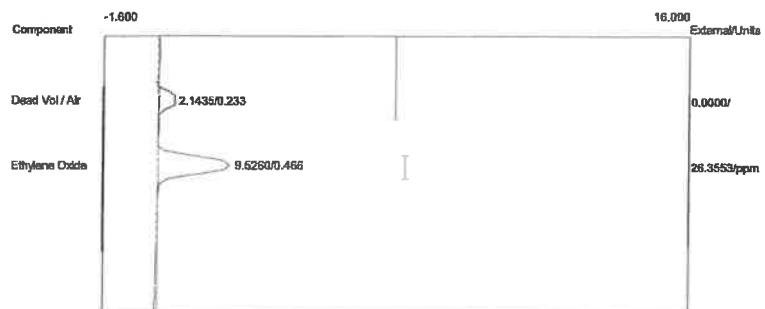


Component	Retention	Area	External	Units
Dead Vol / Air	0.216	2.0870	0.0000	
Ethylene Oxide	0.466	8.3460	23.0906 ppm	
		10.4330	23.0906	



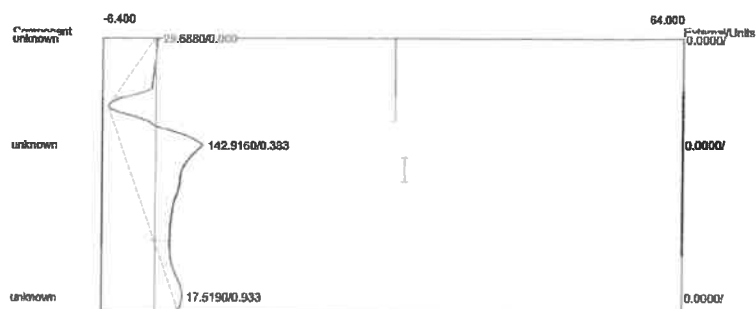
Component	Retention	Area	External	Units
		0.0000	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:23:07  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B09.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



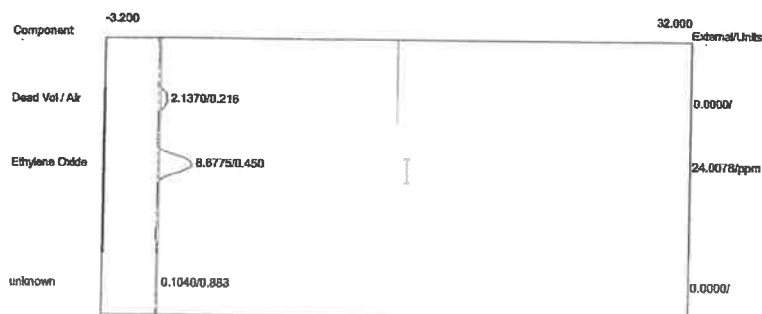
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.1435	0.0000	
Ethylene Oxide	0.466	9.5260	26.3553	ppm
		11.6695	26.3553	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:23:07  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B09.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



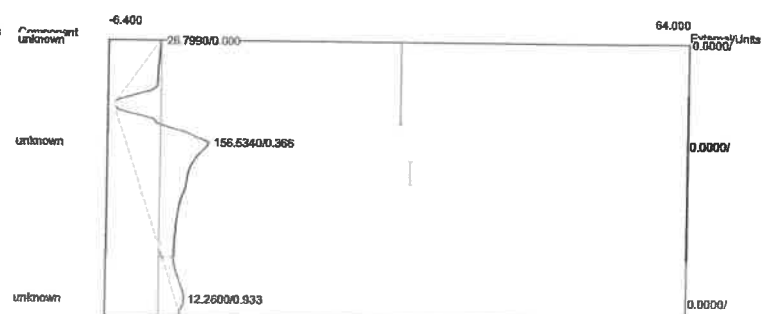
Component	Retention	Area	External	Units
		0.0000	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:24:16  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B10.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



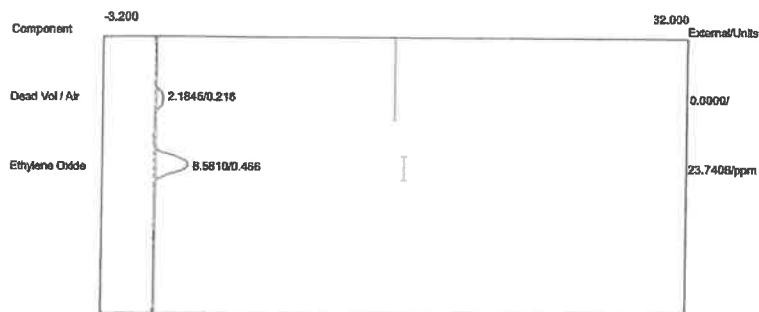
Component	Retention	Area	External Units
Dead Vol / Air	0.216	2.1370	0.0000
Ethylene Oxide	0.450	8.6775	24.0078 ppm
		10.8145	24.0078

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:24:16  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B10.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



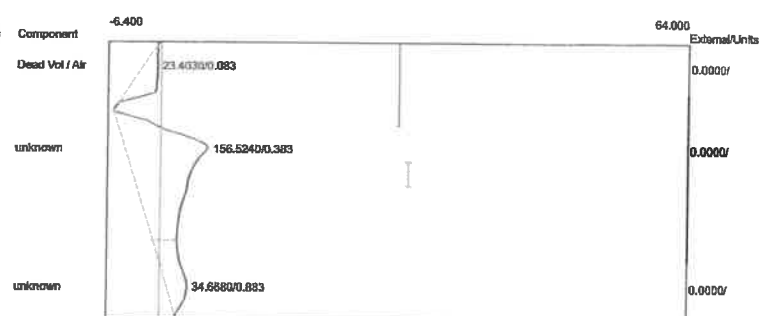
Component	Retention	Area	External Units
		0.0000	0.0000

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:25:27  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B11.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



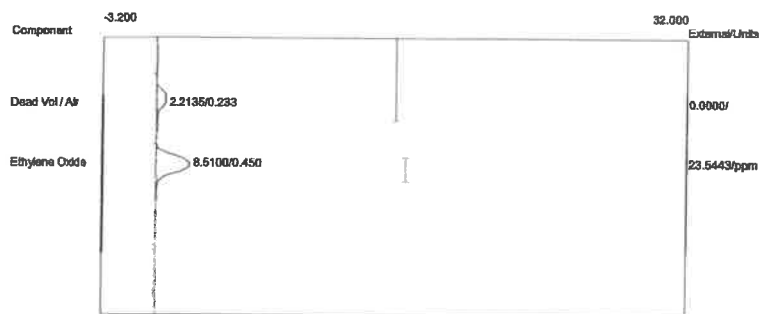
Component	Retention	Area	External Units
Dead Vol / Air	0.216	2.1845	0.0000
Ethylene Oxide	0.466	8.5810	23.7408 ppm
		10.7655	23.7408

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:25:27  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B11.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



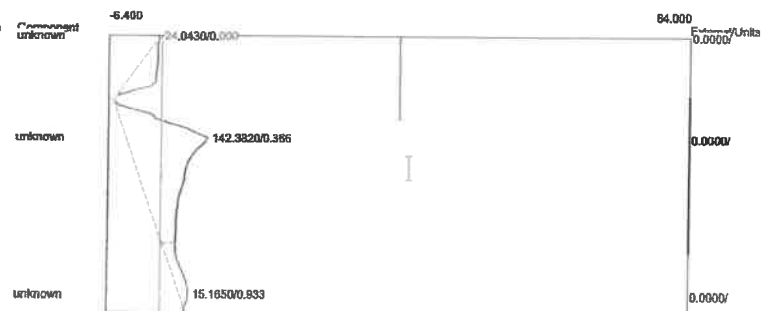
Component	Retention	Area	External Units
Dead Vol / Air	0.083	23.4030	0.0000
		23.4030	0.0000

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:26:36  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B12.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.2135	0.0000	
Ethylene Oxide	0.450	8.5100	23.5443	ppm
		10.7235	23.5443	

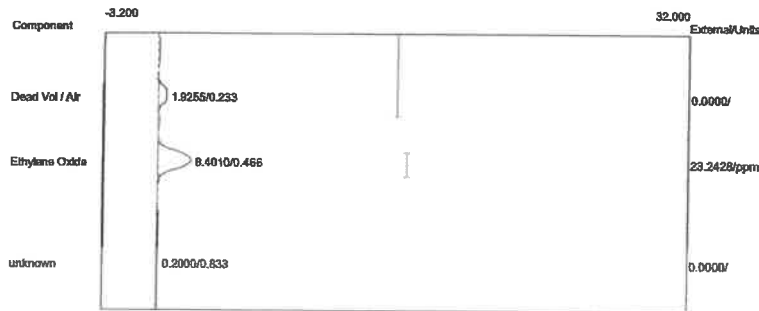
Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:26:36  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B12.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



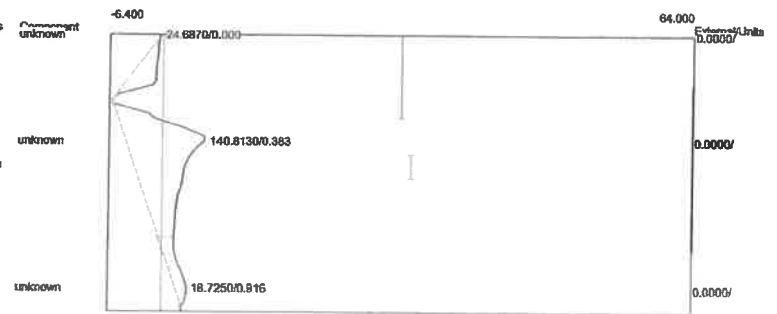
Component	Retention	Area	External	Units
		0.0000	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:27:45  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-1B13.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#1BV  
 Analysis date: 09/21/2018 09:27:45  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-1B13.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



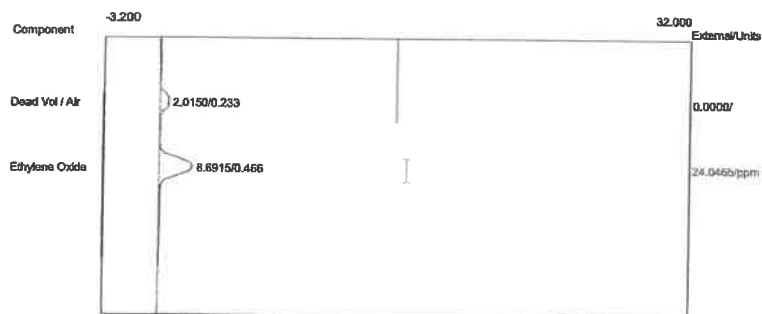
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	1.9255	0.0000	
Ethylene Oxide	0.466	8.4010	23.2428 ppm	
		10.3265	23.2428	



Component	Retention	Area	External	Units
		0.0000	0.0000	

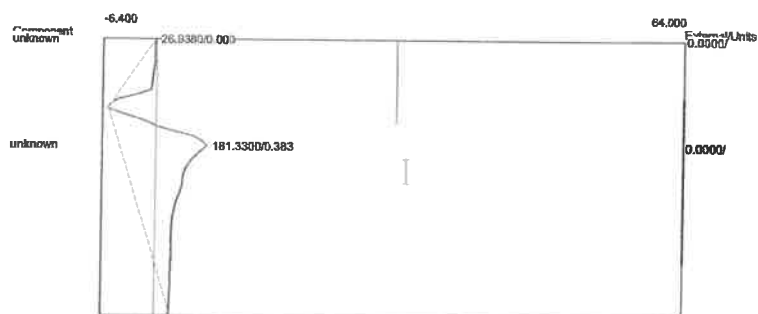


Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:31:03  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B01.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.233	2.0150	0.0000
Ethylene Oxide	0.466	8.6915	24.0465 ppm
		10.7065	24.0465

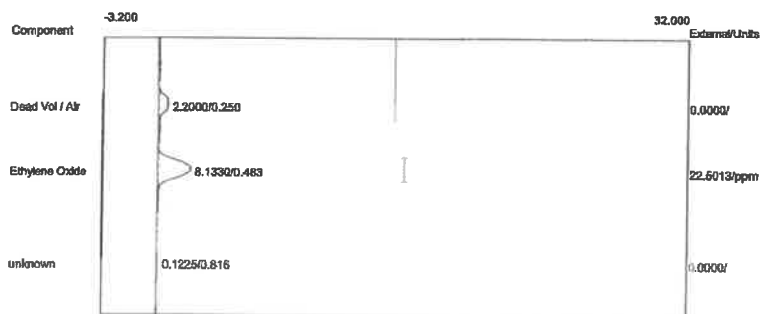
Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:31:03  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B01.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



Component	Retention	Area	External Units
		0.0000	0.0000

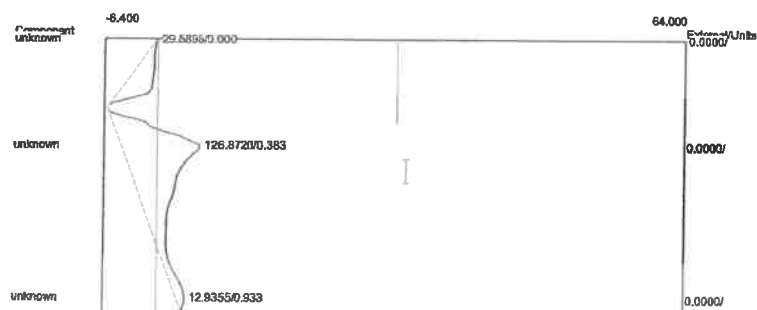


Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:32:13  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B02.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.250	2.2000	0.0000	
Ethylene Oxide	0.483	8.1330	22.5013	ppm
		10.3330	22.5013	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:32:13  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B02.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



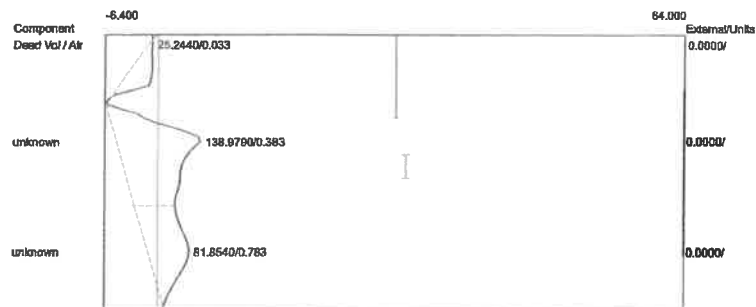
Component	Retention	Area	External	Units
		0.0000	0.0000	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:33:30  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B03.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



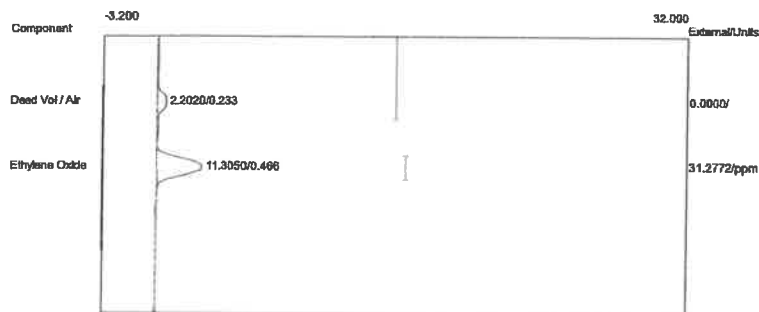
Component	Retention	Area	External	Units
Dead Vol / Air	0.216	2.0750	0.0000	
Ethylene Oxide	0.466	15.2810	42.2775	ppm
		17.3560	42.2775	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:33:30  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B03.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



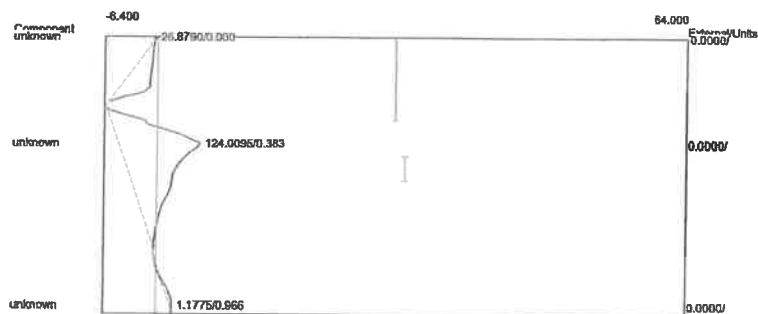
Component	Retention	Area	External	Units
Dead Vol / Air	0.033	25.2440	0.0000	
		25.2440	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:34:38  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B04.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.233	2.2020	0.0000
Ethylene Oxide	0.466	11.3050	31.2772 ppm
		13.5070	31.2772

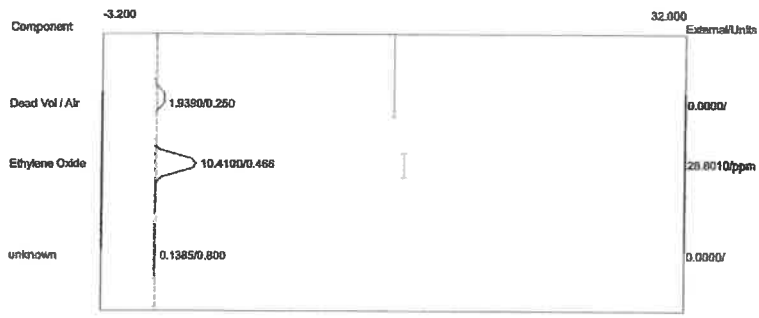
Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:34:38  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B04.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



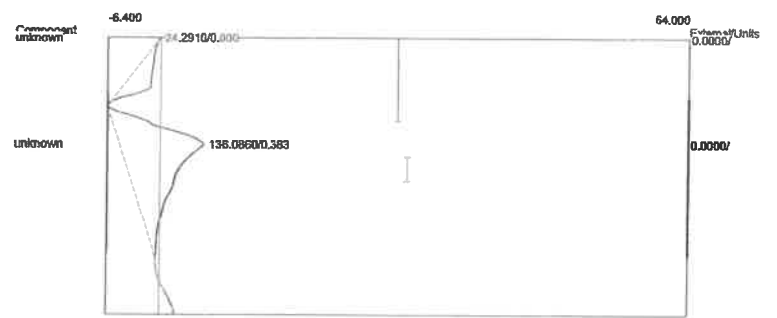
Component	Retention	Area	External Units
		0.0000	0.0000

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:35:43  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B05.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:35:43  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B05.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer

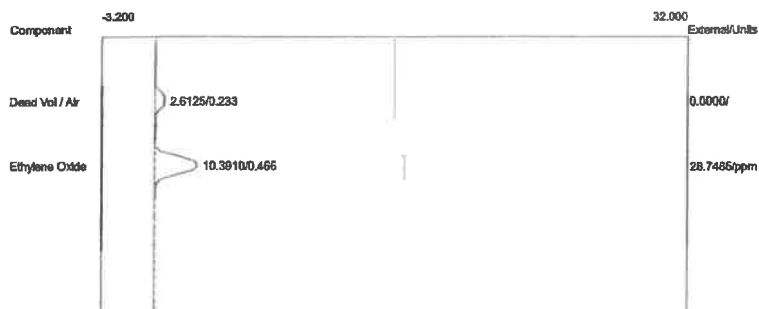


Component	Retention	Area	External	Units
Dead Vol / Air	0.250	1.9390	0.0000	
Ethylene Oxide	0.466	10.4100	28.8010	ppm
		12.3490	28.8010	



Component	Retention	Area	External	Units
		0.0000	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:36:51  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B06.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



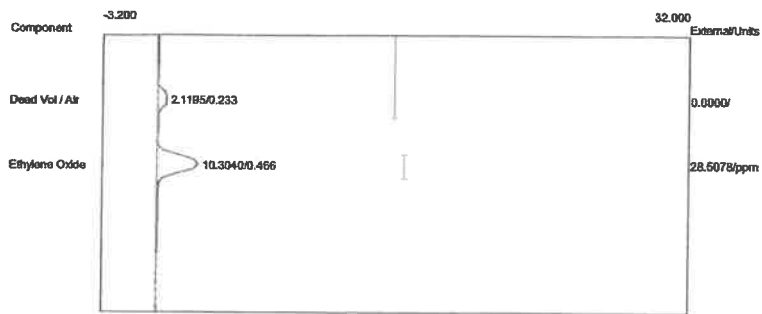
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.6125	0.0000	
Ethylene Oxide	0.466	10.3910	28.7485	ppm
		13.0035	28.7485	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:36:51  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B06.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



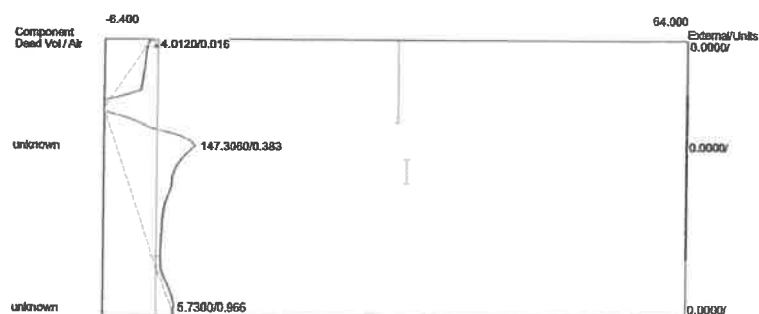
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	23.6110	0.0000	
		23.6110	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:37:58  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tern  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B07.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.233	2.1195	0.0000
Ethylene Oxide	0.466	10.3040	28.5078 ppm
		12.4235	28.5078

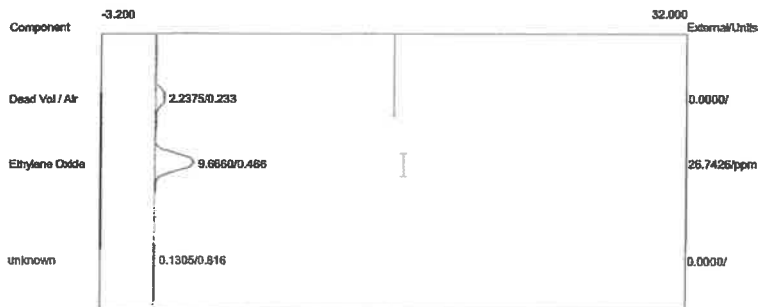
Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:37:58  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tern  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B07.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



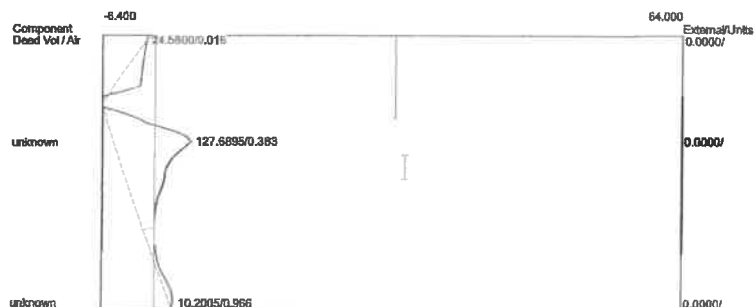
Component	Retention	Area	External Units
Dead Vol / Air	0.016	24.0120	0.0000
		24.0120	0.0000

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:39:06  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B08.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:39:06  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B08.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer

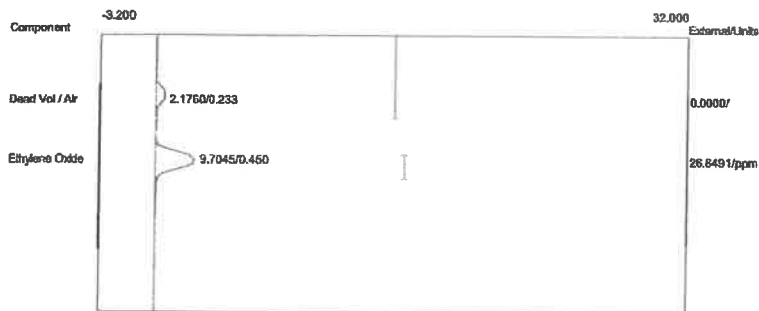


Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.2375	0.0000	
Ethylene Oxide	0.466	9.6660	26.7426	ppm
		11.9035	26.7426	



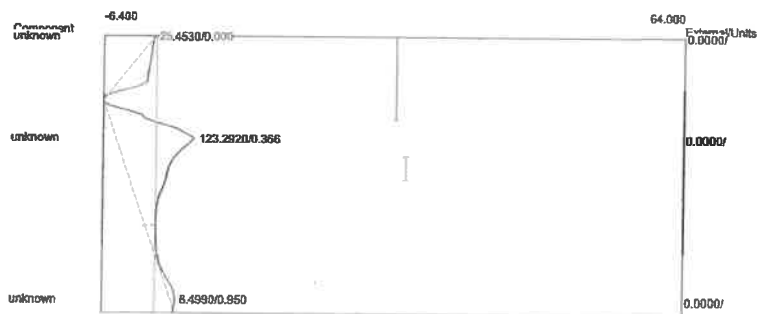
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	24.5800	0.0000	
		24.5800	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:40:13  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B09.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.233	2.1760	0.0000
Ethylene Oxide	0.450	9.7045	26.8491 ppm
		11.8805	26.8491

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:40:13  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B09.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



Component	Retention	Area	External Units
		0.0000	0.0000

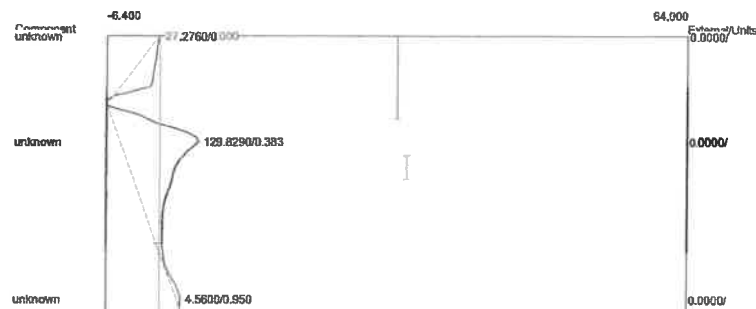


Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:41:21  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B10.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.233	2.1475	0.0000
Ethylene Oxide	0.466	9.5430	26.4023 ppm
		11.6905	26.4023

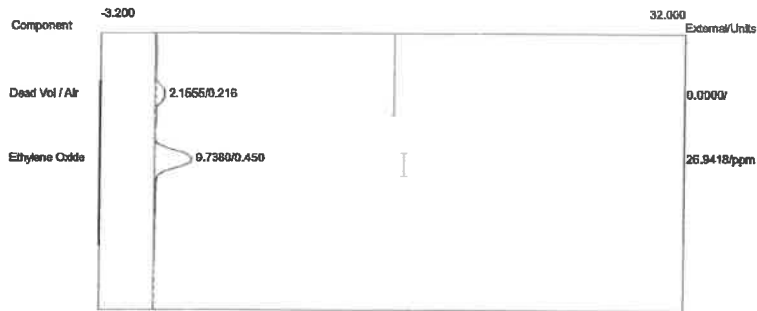
Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:41:21  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B10.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



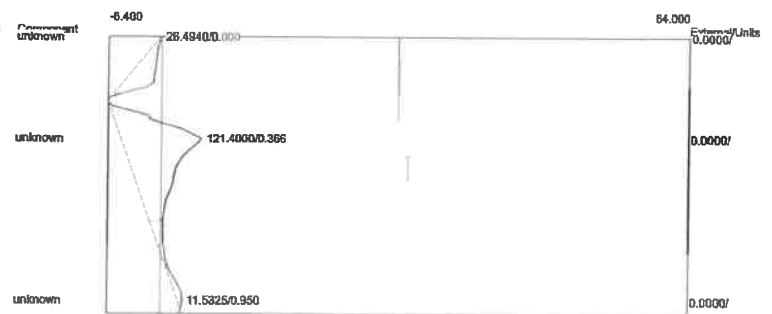
Component	Retention	Area	External Units
		0.0000	0.0000

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:42:29  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B11.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:42:29  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B11.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer

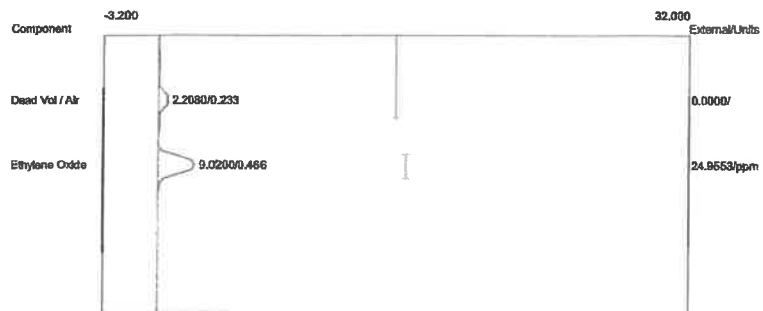


Component	Retention	Area	External Units
Dead Vol / Air	0.216	2.1555	0.0000
Ethylene Oxide	0.450	9.7380	26.9418 ppm
		11.8935	26.9418



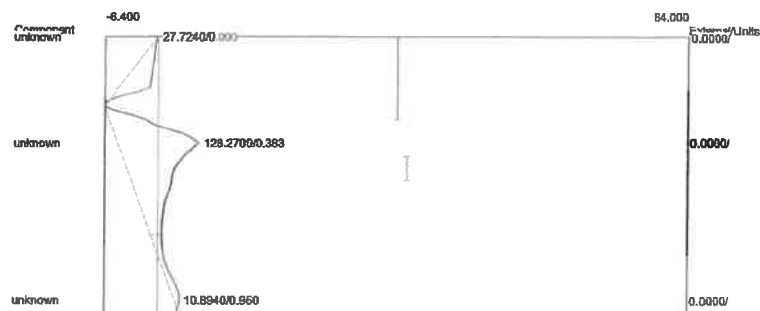
Component	Retention	Area	External Units
		0.0000	0.0000

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:43:37  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B12.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



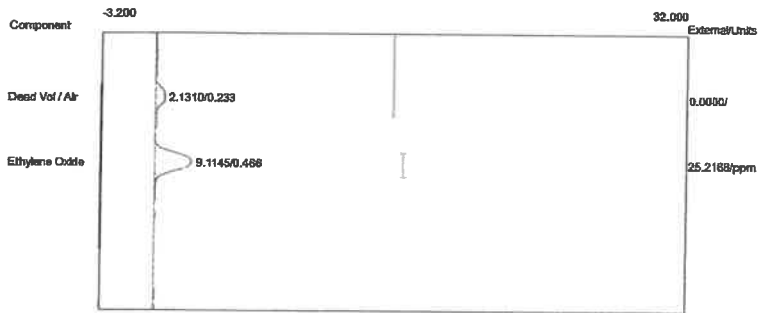
Component	Retention	Area	External Units
Dead Vol / Air	0.233	2.2080	0.0000
Ethylene Oxide	0.466	9.0200	24.9553 ppm
		11.2280	24.9553

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:43:37  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B12.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



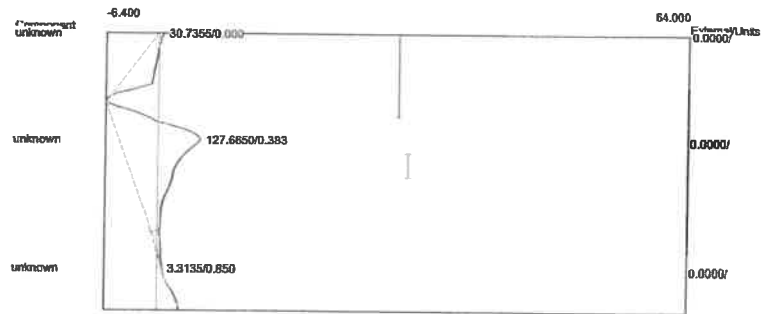
Component	Retention	Area	External Units
unknown	0.000	0.0000	0.0000
unknown	0.383	0.0000	0.0000
unknown	0.950	0.0000	0.0000

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:44:42  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-2B13.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.1310	0.0000	
Ethylene Oxide	0.466	9.1145	25.2168	ppm
		11.2455	25.2168	

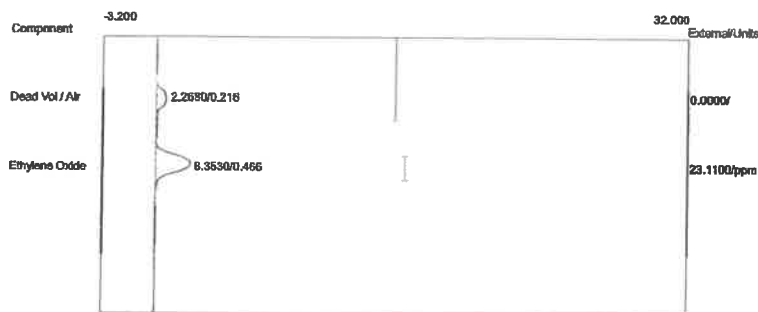
Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#2BV  
 Analysis date: 09/21/2018 09:44:42  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-2B13.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
			0.0000	0.0000

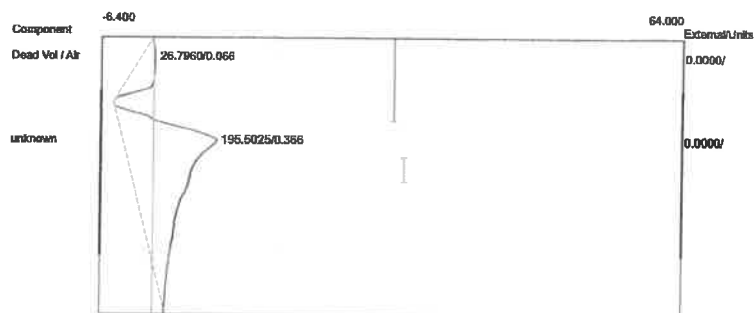


Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:53:04  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B01.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



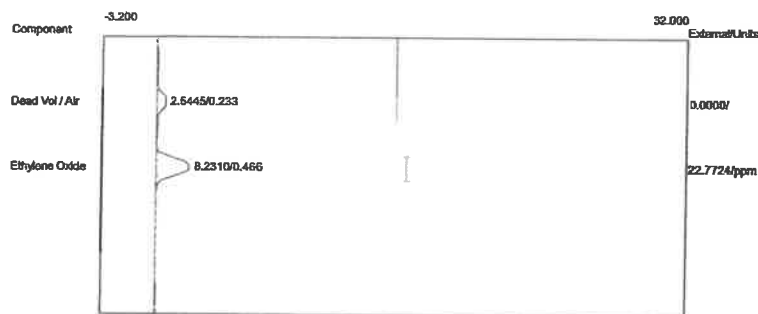
Component	Retention	Area	External	Units
Dead Vol / Air	0.216	2.2680	0.0000	
Ethylene Oxide	0.466	8.3530	23.1100 ppm	
		10.6210	23.1100	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:53:04  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B01.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



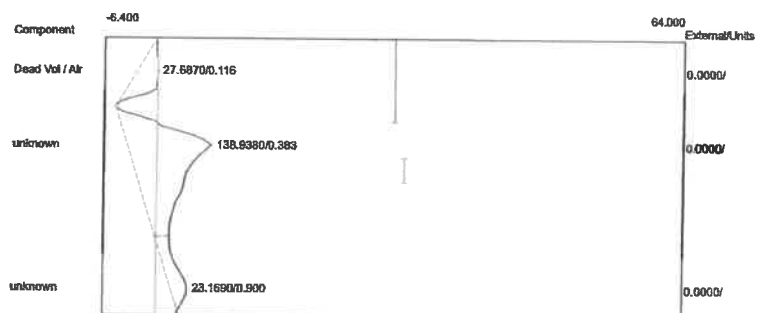
Component	Retention	Area	External	Units
Dead Vol / Air	0.066	26.7960	0.0000	
		26.7960	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:54:14  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B02.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



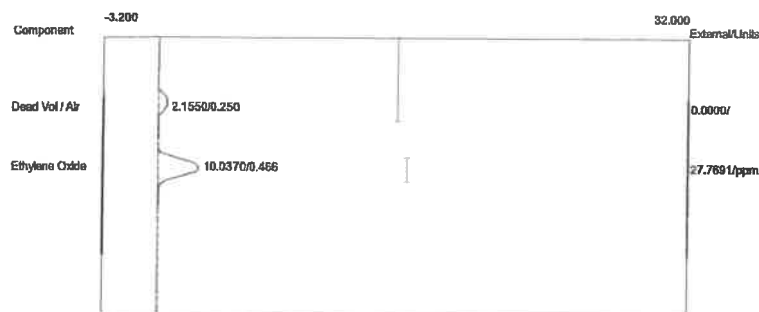
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.5445	0.0000	
Ethylene Oxide	0.466	8.2310	22.7724	ppm
		10.7755	22.7724	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:54:14  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B02.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



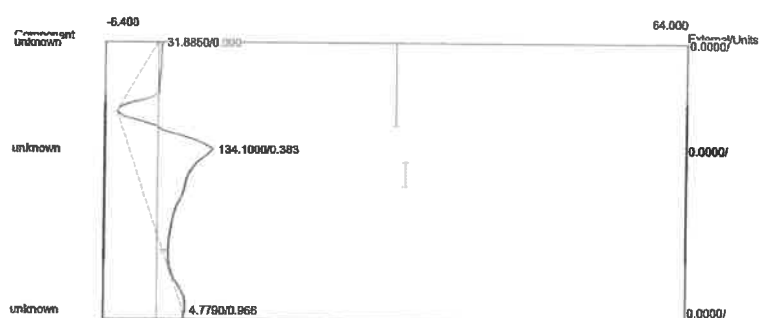
Component	Retention	Area	External	Units
Dead Vol / Air	0.116	27.6870	0.0000	
		27.6870	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:55:22  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B03.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.250	2.1550	0.0000	
Ethylene Oxide	0.466	10.0370	27.7691 ppm	
		12.1920	27.7691	

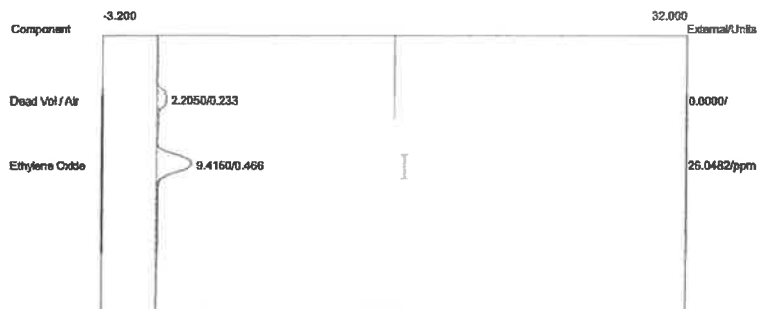
Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:55:22  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B03.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
		0.0000	0.0000	

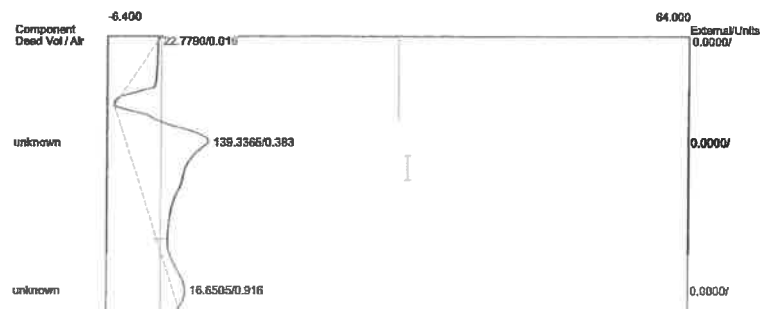


Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:56:32  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tern  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B04.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



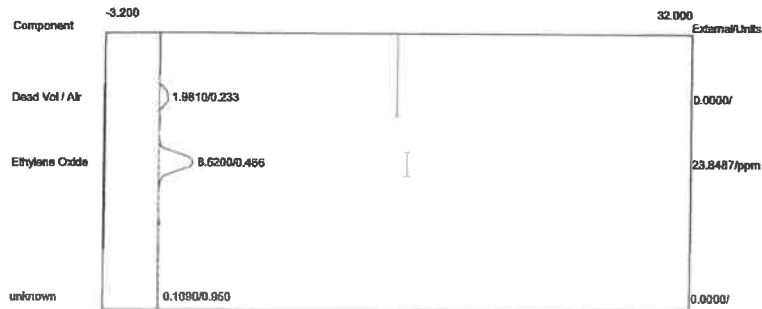
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.2050	0.0000	
Ethylene Oxide	0.466	9.4150	26.0482	ppm
		11.6200	26.0482	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:56:32  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tern  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B04.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



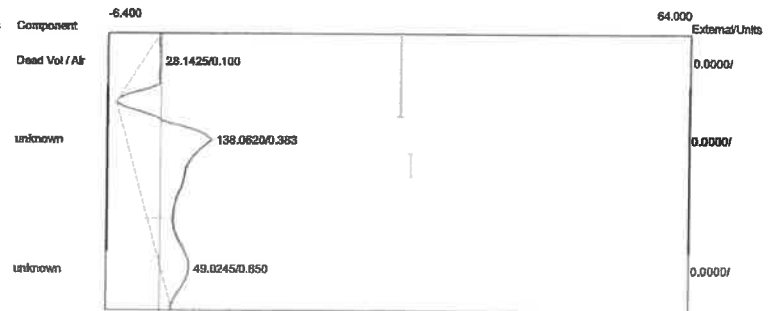
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	22.7790	0.0000	
		22.7790	0.0000	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:57:46  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B05.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



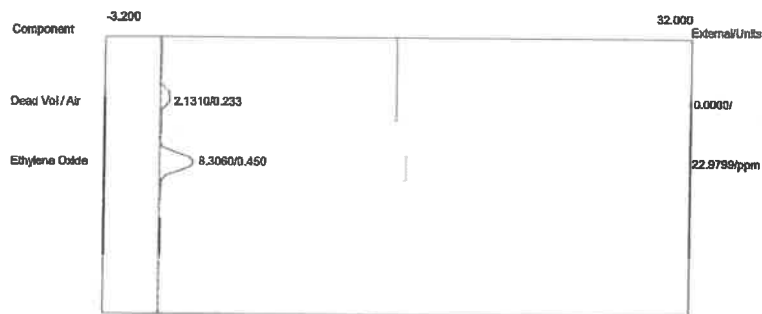
Component	Retention	Area	External Units
Dead Vol / Air	0.233	1.9810	0.0000
Ethylene Oxide	0.466	8.6200	23.8487 ppm
	10.6010	23.8487	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:57:46  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B05.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



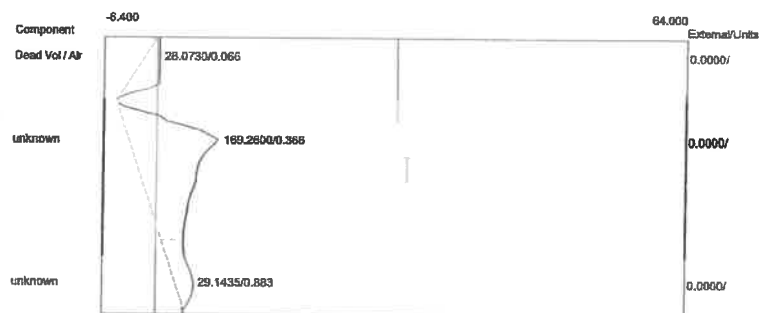
Component	Retention	Area	External Units
Dead Vol / Air	0.100	28.1425	0.0000
		28.1425	0.0000

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:58:56  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B06.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



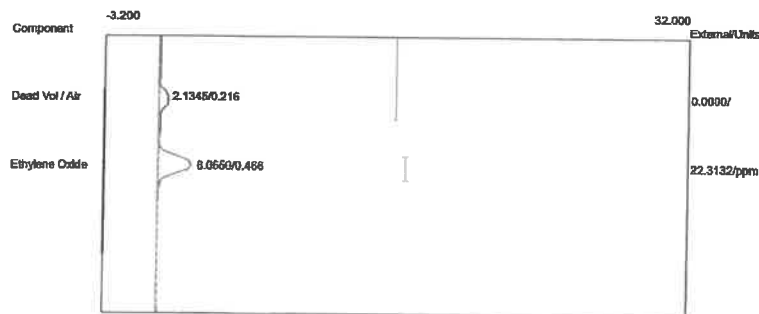
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.1310	0.0000	
Ethylene Oxide	8.3060	22.9799	ppm	
		10.4370	22.9799	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 09:58:56  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B06.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



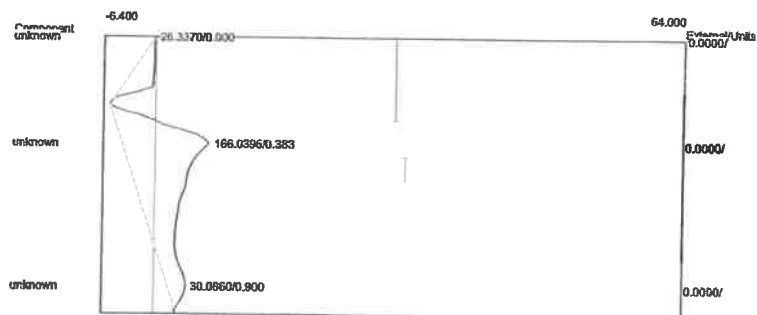
Component	Retention	Area	External	Units
Dead Vol / Air	0.066	28.0730	0.0000	
		28.0730	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:00:07  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B07.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



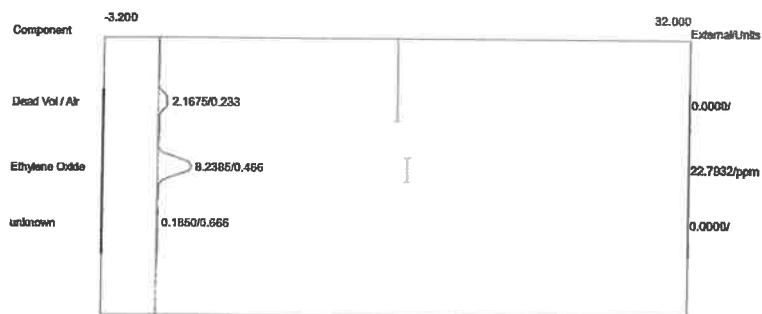
Component	Retention	Area	External Units
Dead Vol / Air	0.216	2.1345	0.0000
Ethylene Oxide	0.466	8.0650	22.3132 ppm
		10.1995	22.3132

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:00:07  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B07.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



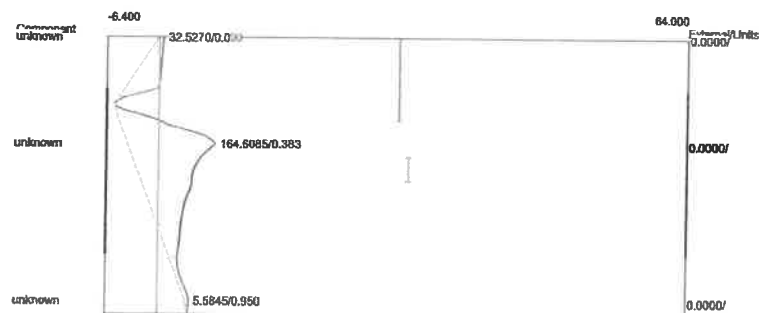
Component	Retention	Area	External Units
		0.0000	0.0000

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:01:14  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B08.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



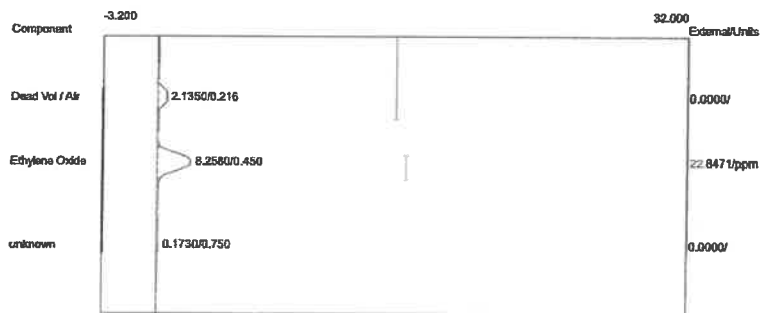
Component	Retention	Area	External Units
Dead Vol / Air	0.233	2.1675	0.0000
Ethylene Oxide	0.466	8.2385	22.7932 ppm
		10.4060	22.7932

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:01:14  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B08.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



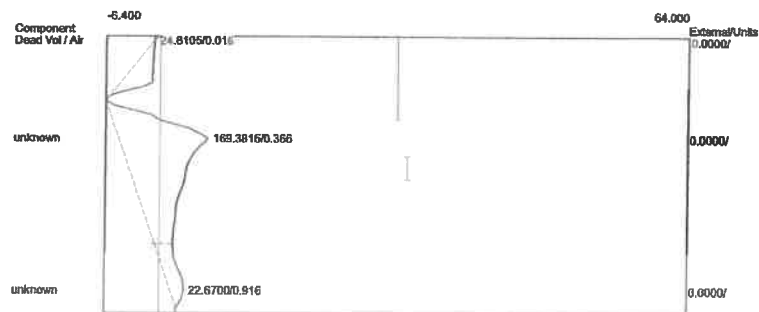
Component	Retention	Area	External Units
		0.0000	0.0000

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:02:23  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B09.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



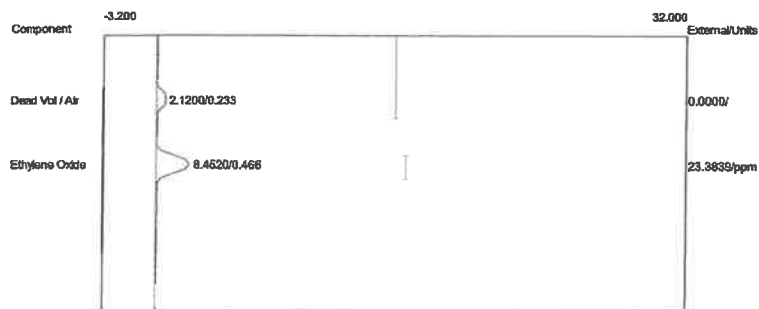
Component	Retention	Area	External	Units
Dead Vol / Air	0.216	2.1350	0.0000	
Ethylene Oxide	0.450	8.2580	22.8471	ppm
		10.3930	22.8471	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:02:23  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B09.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



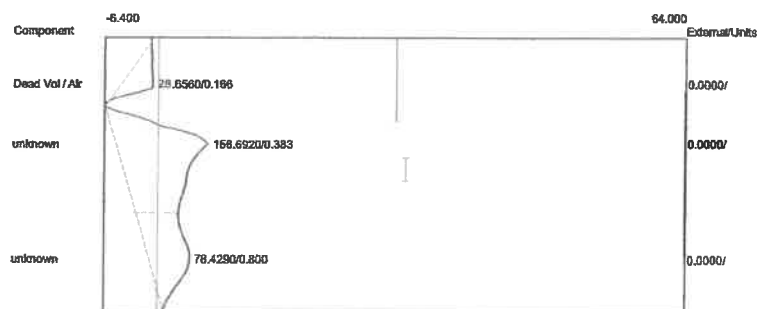
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	24.8105	0.0000	
		24.8105	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:03:40  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B10.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



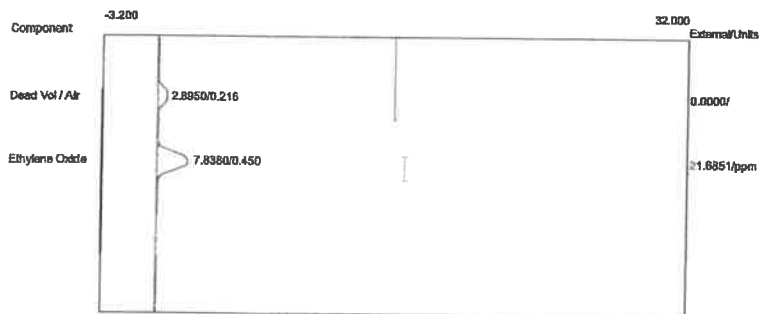
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.1200	0.0000	
Ethylene Oxide	0.466	8.4520	23.3839	ppm
		10.5720	23.3839	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:03:40  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B10.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



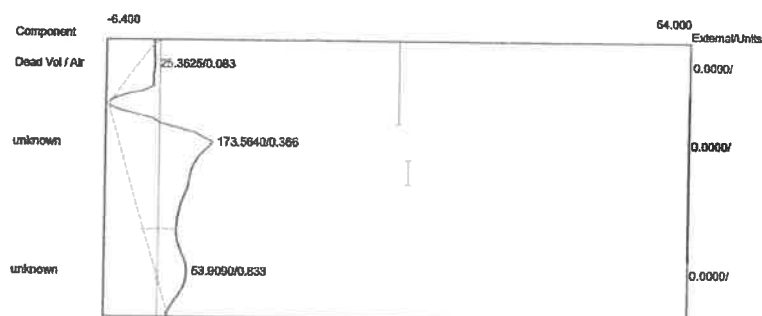
Component	Retention	Area	External	Units
Dead Vol / Air	0.166	28.6560	0.0000	
		28.6560	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:04:53  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B11.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.216	2.8950	0.0000	
Ethylene Oxide	0.450	7.8380	21.6851	ppm
		10.7330	21.6851	

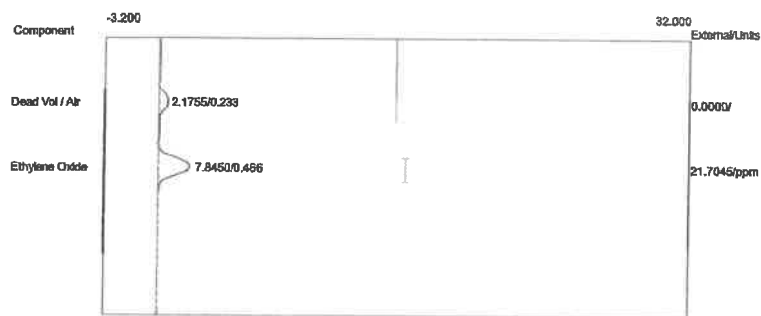
Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:04:53  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B11.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.083	25.3625	0.0000	
		25.3625	0.0000	

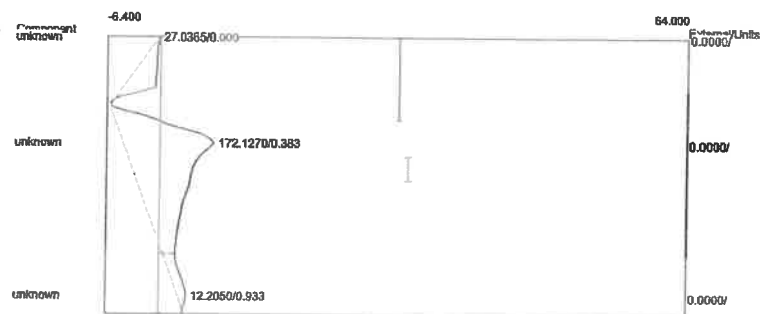


Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:06:02  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-3B12.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



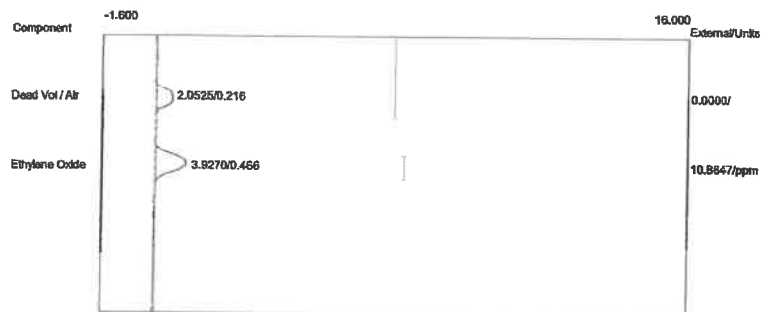
Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.1755	0.0000	
Ethylene Oxide	0.466	7.8450	21.7045	ppm
		10.0205	21.7045	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Run#3BV  
 Analysis date: 09/21/2018 10:06:02  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-3B12.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



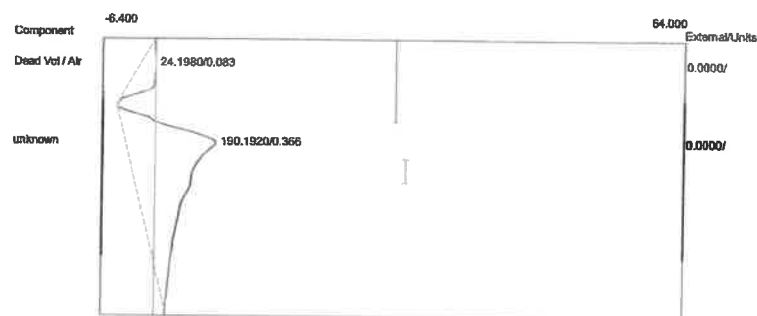
Component	Retention	Area	External	Units
		0.0000	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Aeration  
 Analysis date: 09/21/2018 09:09:51  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-A04.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



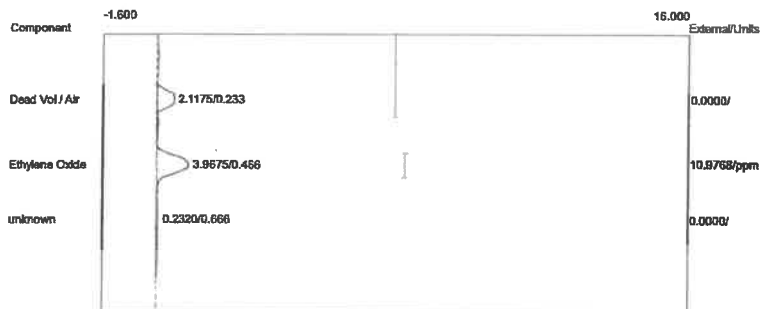
Component	Retention	Area	External Units
Dead Vol / Air	0.216	2.0525	0.0000
Ethylene Oxide	0.466	3.9270	10.8647 ppm
		5.9795	10.8647

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Aeration  
 Analysis date: 09/21/2018 09:09:51  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-A04.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



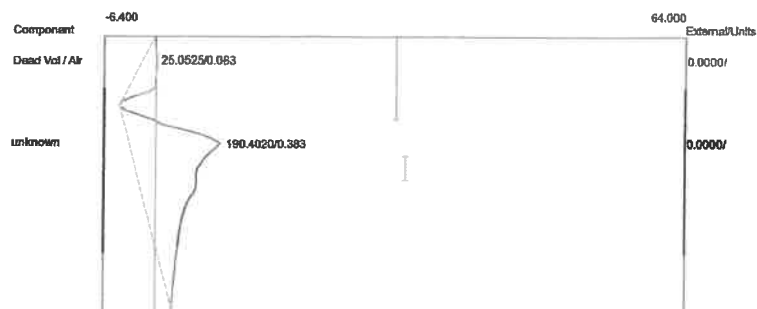
Component	Retention	Area	External Units
Dead Vol / Air	0.083	24.1980	0.0000
		24.1980	0.0000

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Aeration  
 Analysis date: 09/21/2018 09:07:10  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-A03.CHR (c:\peak359)  
 Sample: AAT Inlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.233	2.1175	0.0000	
Ethylene Oxide	0.466	3.9675	10.9768	ppm
		6.0850	10.9768	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: Aeration  
 Analysis date: 09/21/2018 09:07:10  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbowack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-A03.CHR (c:\peak359)  
 Sample: AAT Outlet  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.083	25.0525	0.0000	
		25.0525	0.0000	

## **APPENDIX F**

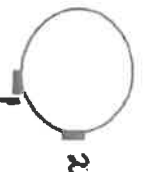
### **Field Data**

# ECSI, INC. - VELOCITY TRAVERSE DATA

Client: Sterigenics  
 Location: Willowbrook - Plant 1  
 Source: AAT Safe Cell S/stem Inlet

Run #: 1  
 Date: 5/21/14  
 Probe Type: Std.  
 Stack I.D.: 36 In.  
 Baro Press: 29.66  
 DSCFM: 26.95

Port Sketch:



## Port 1

Inches From Port	Point#	Delta P				Stack Temp (F)	Cyclonic Angle	Point#	Delta P				Stack Temp (F)	Cyclonic Angle
		Low	High	Average	Sq Root				Low	High	Average	Sq Root		
0.7	1	0.25	0.25	#DIV/0!	#DIV/0!	101.2	1.5	1	0.21	0.21	#DIV/0!	#DIV/0!	103.3	5.0
2.4	2	0.15	0.15	#DIV/0!	#DIV/0!	101.2	5.6	2	0.22	0.22	#DIV/0!	#DIV/0!	103.3	4.6
4.2	3	0.18	0.18	#DIV/0!	#DIV/0!	101.7	2.0	3	0.21	0.21	#DIV/0!	#DIV/0!	103.2	3.6
6.3	4	0.20	0.20	#DIV/0!	#DIV/0!	102.2	1.8	4	0.25	0.25	#DIV/0!	#DIV/0!	103.1	5.1
9.0	5	0.21	0.21	#DIV/0!	#DIV/0!	102.4	1.0	5	0.23	0.23	#DIV/0!	#DIV/0!	102.9	3.0
12.9	6	0.25	0.25	#DIV/0!	#DIV/0!	102.5	0.5	6	0.25	0.25	#DIV/0!	#DIV/0!	102.8	2.6
23.1	7	0.21	0.21	#DIV/0!	#DIV/0!	103.5	1.0	7	0.16	0.16	#DIV/0!	#DIV/0!	102.6	8.8
27.0	8	0.23	0.23	#DIV/0!	#DIV/0!	104	1.2	8	0.19	0.19	#DIV/0!	#DIV/0!	102.6	6.3
29.7	9	0.17	0.25	#DIV/0!	#DIV/0!	104.3	2.5	9	0.24	0.24	#DIV/0!	#DIV/0!	102.5	4.1
31.8	10	0.19	0.19	#DIV/0!	#DIV/0!	104.4	0.5	10	0.22	0.22	#DIV/0!	#DIV/0!	102.5	2.2
33.6	11	0.26	0.26	#DIV/0!	#DIV/0!	104.6	1.3	11	0.26	0.26	#DIV/0!	#DIV/0!	102.4	2.8
35.3	12	0.19	0.19	#DIV/0!	#DIV/0!	105	1.8	12	0.22	0.22	#DIV/0!	#DIV/0!	102.5	2.1
	13							13						
	14							14						
	15							15						
	16							16						
	17							17						
	18							18						
	19							19						
	20							20						
	21							21						
	22							22						
	23							23						
	24							24						

\* Stack static pressure measured at -0.25' H2O

Average Values:

#DIV/0! #DIV/0! #DIV/0! #DIV/0!

\* Pilot tube P-41-2 was last checked @ 2' H2O, max scale on the manometer

# ECSI, INC. - VELOCITY TRAVERSE DATA

Client: Sterigenics

Location: Willowbrook - Plant 1

Source: AAT Safe Cell System Inlet

Run #: 1

Date: 6/21/14

~~6/26/2014~~

Port Sketch:

Probe Type: Std.

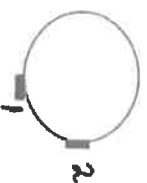
Std.

Baro Press: 29.00

Stack I.D.: 36 in.

Stack I.D.: 36 in.

DSCFM:



## Port 1

## Port 2

Inches From Port	Point#	Delta P				Stack Temp (F)	Cyclonic Angle	Point#	Delta P				Stack Temp (F)	Cyclonic Angle
		Low	High	Average	Sq Root				Low	High	Average	Sq Root		
0.7	1	0.25	0.25	#DIV/0!	#DIV/0!	101.2	1.5	1	0.21	0.21	#DIV/0!	#DIV/0!	103.3	5.0
2.4	2	0.15	0.15	#DIV/0!	#DIV/0!	101.2	5.6	2	0.22	0.22	#DIV/0!	#DIV/0!	103.3	4.6
4.2	3	0.18	0.18	#DIV/0!	#DIV/0!	101.7	2.0	3	0.21	0.21	#DIV/0!	#DIV/0!	103.2	3.6
6.3	4	0.20	0.20	#DIV/0!	#DIV/0!	102.2	1.8	4	0.25	0.25	#DIV/0!	#DIV/0!	103.1	5.1
9.0	5	0.21	0.21	#DIV/0!	#DIV/0!	102.4	1.0	5	0.23	0.23	#DIV/0!	#DIV/0!	102.9	3.0
12.9	6	0.25	0.25	#DIV/0!	#DIV/0!	102.5	0.5	6	0.25	0.25	#DIV/0!	#DIV/0!	102.8	2.6
23.1	7	0.21	0.21	#DIV/0!	#DIV/0!	103.5	1.0	7	0.16	0.16	#DIV/0!	#DIV/0!	102.6	8.8
27.0	8	0.23	0.23	#DIV/0!	#DIV/0!	104	1.7	8	0.19	0.19	#DIV/0!	#DIV/0!	102.6	6.3
29.7	9	0.17	0.25	#DIV/0!	#DIV/0!	104.3	2.5	9	0.24	0.24	#DIV/0!	#DIV/0!	102.5	4.1
31.8	10	0.19	0.19	#DIV/0!	#DIV/0!	104.4	0.5	10	0.22	0.22	#DIV/0!	#DIV/0!	102.5	2.2
33.6	11	0.26	0.26	#DIV/0!	#DIV/0!	104.6	1.3	11	0.26	0.26	#DIV/0!	#DIV/0!	102.4	2.8
35.3	12	0.19	0.19	#DIV/0!	#DIV/0!	105	1.8	12	0.22	0.22	#DIV/0!	#DIV/0!	102.5	2.1
	13							13						
	14							14						
	15							15						
	16							16						
	17							17						
	18							18						
	19							19						
	20							20						
	21							21						
	22							22						
	23							23						
	24							24						

Average Values: #DIV/0! #DIV/0! #DIV/0! #DIV/0!

\* Pitot tube P-4-2 was not checked @ 2" H<sub>2</sub>O, max scale on the manometer

# ECSI, INC. - VELOCITY TRAVERSE DATA

Client: Sterigenics

Location: Willowbrook - Plant 1

Source: AAT Safe Cell System Outlet

Run #: 1

Date: 9/21/18

Port Sketch:

Probe Type: Std.

Baro Press: 29.96

~~29.96~~ 29.95

Stack I.D.: 20x30

DSCFM:           

0000  
1234

≅ 4.17 ft/s

## Port 1 & 2

## Port 3 & 4

Inches From Port	Point#	Delta P			Stack Temp (F)	Cyclonic Angle	Point#	Delta P			Stack Temp (F)	Cyclonic Angle
		Low	High	Average				Low	High	Average		
2.5	1	0.55	0.55	#DIV/0!	97.8	3.8	1	0.45	0.45	#DIV/0!	109.5	1.8
5.0	2	0.70	0.70	#DIV/0!	107.7	4.8	2	0.52	0.52	#DIV/0!	105.9	2.2
7.5	3	0.75	0.75	#DIV/0!	109.1	3.0	3	0.42	0.42	#DIV/0!	107.0	2.5
10.0	4	0.80	0.80	#DIV/0!	109.4	0.8	4	0.50	0.50	#DIV/0!	108.1	2.8
12.5	5	0.85	0.85	#DIV/0!	109.5	1.8	5	0.70	0.70	#DIV/0!	109.1	2.6
15.0	6	1.09	1.09	#DIV/0!	107.6	0.5	6	0.71	0.71	#DIV/0!	109.1	2.6
17.5	7	1.3	1.3	#DIV/0!	101.5	1.8	7	0.45	0.45	#DIV/0!	104.5	1.8
2.5	1	0.35	0.35	#DIV/0!	104.8	3.0	1	0.52	0.52	#DIV/0!	105	2.0
5.0	2	0.45	0.45	#DIV/0!	108.6	1.2	2	0.40	0.40	#DIV/0!	109.1	3.6
7.5	3	0.38	0.38	#DIV/0!	109.0	3.2	3	0.40	0.40	#DIV/0!	109.0	3.5
10.0	4	0.60	0.60	#DIV/0!	108.1	4.5	4	0.80	0.80	#DIV/0!	108.1	5.2
12.5	5	0.44	0.44	#DIV/0!	109.1	5.2	5	0.85	0.85	#DIV/0!	107.1	1.8
15.0	6	0.60	0.60	#DIV/0!	109.1	5.2	6	0.85	0.85	#DIV/0!	107.1	1.8
17.5	7	0.90	0.90	#DIV/0!	109.1	5.2	7	0.85	0.85	#DIV/0!	107.1	1.8

\* Stack static pressure measured at 0.35" H<sub>2</sub>O

\* Pitot tube P-42 was leak checked @ 2" H<sub>2</sub>O, max scale on the manometer

# ECSI, INC. - VELOCITY TRAVERSE DATA

Client: Sterigenics

Run #: 1

Date: 8/21/18

Port Sketch:

Location: Willowbrook - Plant 1

Probe Type: Std.

Baro Press:

29.95 inHg

Source: AAT Safe Cell System Outlet

Stack I.D.: 20x30

DSCFM:

0000  
1234

## Port 1 & 2

## Port 3 & 4

Inches From Port	Point#	Delta P				Stack Temp (F)	Cyclonic Angle	Point#	Delta P				Stack Temp (F)	Cyclonic Angle
		Low	High	Average	Sq Root				Low	High	Average	Sq Root		
2.5	1	0.55	0.55	#DIV/0!	#DIV/0!	97.8	3.8	1	0.55	0.55	0.55	#DIV/0!	104.5	1.8
5.0	2	0.70	0.70	#DIV/0!	#DIV/0!	107.7	4.8	2	0.52	0.52	0.52	#DIV/0!	105.05	2.8
7.5	3	0.75	0.75	#DIV/0!	#DIV/0!	109.1	3.0	3	0.42	0.42	0.42	#DIV/0!	107.01	2.5
10.0	4	0.80	0.80	#DIV/0!	#DIV/0!	109.4	0.8	4	0.50	0.50	0.50	#DIV/0!	108.1	2.8
12.5	5	0.85	0.85	#DIV/0!	#DIV/0!	109.5	1.8	5	0.70	0.70	0.70	#DIV/0!	108.9	2.2
15.0	6	1.09	1.09	#DIV/0!	#DIV/0!	109.6	0.5	6	0.81	0.81	0.81	#DIV/0!	109.1	2.6
17.5	7	1.3	1.3	#DIV/0!	#DIV/0!	101.5	1.8	7	0.45	0.45	0.45	#DIV/0!	104.5	1.8
2.5	1	0.35	0.35	#DIV/0!	#DIV/0!	101.5	1.8	1	0.52	0.52	0.52	#DIV/0!	105	2.0
5.0	2	0.38	0.38	#DIV/0!	#DIV/0!	107.9	2.0	2	0.40	0.40	0.40	#DIV/0!	107.1	3.6
7.5	3	0.45	0.45	#DIV/0!	#DIV/0!	108.6	1.2	3	0.40	0.40	0.40	#DIV/0!	109.0	3.5
10.0	4	0.38	0.38	#DIV/0!	#DIV/0!	109.1	4.5	4	0.80	0.80	0.80	#DIV/0!	108	5.2
12.5	5	0.44	0.44	#DIV/0!	#DIV/0!	109.1	5.2	5				#DIV/0!		
15.0	6	0.60	0.60	#DIV/0!	#DIV/0!			6				#DIV/0!		
17.5	7	0.90	0.90	#DIV/0!	#DIV/0!			7				#DIV/0!		

Average Values:

#DIV/0!

#DIV/0!

#DIV/0!

#DIV/0!

\* Pilot tube P-42 was leak checked @ 2" H<sub>2</sub>O, max scale on the manometer

2.6  
2.2  
3.6



WB1 Backvent

Run#1

9/21/18

Inj	$\Delta P$ In/out	Temp In/out
1	.34/.62	104/104
2	.34/.62	104/104
3	.32/.62	104/104
4	.32/.60	104/104
5	.32/.60	104/104
6	.34/.60	104/104
7	.34/.60	103/103
8	.32/.62	104/104
9	.32/.60	103/103
10	.32/.60	104/104
11	.32/.60	104/104
12	.32/.61	104/104
13	.32/.61	104/104
14		
15		

WB.1 Backvent

Run#2

9/21/18

Inj	$\Delta P$ In/out	Temp In/out
1	.34/.62	104/104
2	.34/.62	104/104
3	.32/.62	105/105
4	.34/.62	104/104
5	.32/.62	104/104
6	.34/.62	104/104
7	.34/.62	104/104
8	.34/.62	104/104
9	.32/.62	104/104
10	.32/.62	104/104
11	.32/.62	104/104
12	.32/.63	104/104
13	.32/.63	104/104
14		
15		

WB1 Backvent

Run#3

9/21/18

Inj	$\Delta P$ in/out	Temp in/out
1	.32/.63	105/105
2	.34/.63	105/105
3	.32/.63	105/105
4	.32/.63	105/105
5	.32/.64	105/105
6	.32/.64	105/105
7	.32/.64	105/105
8	.33/.64	105/105
9	.32/.64	105/105
10	.32/.63	105/105
11	.32/.64	105/105
12	.32/.63	104/104
13		

(1)

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Elev 620ft 41.79 °N, 87.75 °W

# Chicago-Midway, IL ★ 🏠

☀️ **58° CHICAGO-MIDWAY STATION** (/HISTORY/DAILY/US/IL/CHICAGO-MIDWAY/KMDW/DATE/2018-10-16?CM\_VEN=LOCALWX\_PWSDASH) | [CHANGE](#) ▼

[HISTORY \(/HISTORY/DAILY/US/IL/CHICAGO-MIDWAY/KMDW/DATE/2018-10-16\)](#)

- [TODAY \(/WEATHER/US/IL/CHICAGO/KMDW\)](#)
- [HOURLY \(/HOURLY/US/IL/CHICAGO/KMDW\)](#)
- [10-DAY \(/FORECAST/US/IL/CHICAGO/KMDW\)](#)
- [CALENDAR \(/CALENDAR/US/IL/CHICAGO-MIDWAY/KMDW/DATE/2018-10\)](#)
- [HISTORY \(/HISTORY/DAILY/US/IL/CHICAGO-MIDWAY/KMDW/DATE/2018-10-16\)](#)
- [WUNDERMAP \(/WUNDERMAP?LAT=41.78583145&LON=-87.75222015\)](#)

Daily

Weekly

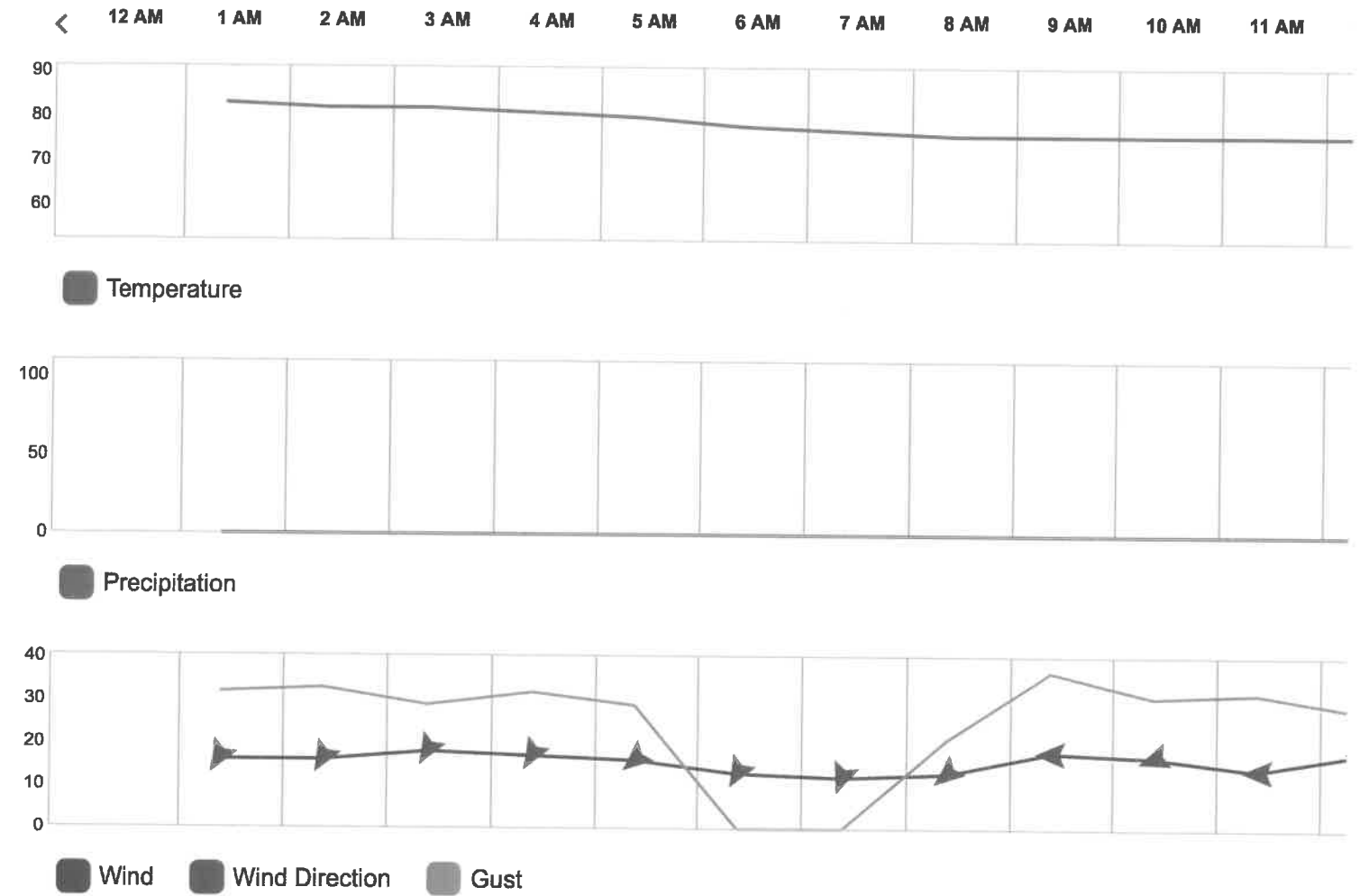
Monthly

September

21

2018

[View](#)



# Summary

Temperature (° F)	Actual	Historic Avg.	Record	▲
High Temp	83	73	95	
Low Temp	58	55	40	
Day Average Temp	71	64	-	
Precipitation (Inches)	Actual	Historic Avg.	Record	▲
Precipitation	1e-16	0.11	1.67	
Month to Date	1.48	2.37	-	
Year to Date	27.28	28.92	-	
Degree Days (° F)	Actual	Historic Avg.	Record	▲

Temperature (° F)	Actual	Historic Avg.	Record	▲
Heating Degree Days	0	3	-	
HDD Month to Date	0	35	-	
HDD Since July 1	0	40	-	
Cooling Degree Days	6	3	-	
CDD Month to Date	196	103	-	
CDD Year to Date	1361	1013	-	
Growing Degree Days	20	-	-	
Dew Point (° F)	Actual	Historic Avg.	Record	▲
Dew Point	56	-	-	
High	68	-	-	
Low	41	-	-	
Average	56	-	-	
Wind (MPH)	Actual	Historic Avg.	Record	▲
Max Wind Speed	28	-	-	
Visibility	10	-	-	
Sea Level Pressure (Hg)	Actual	Historic Avg.	Record	▲
Sea Level Pressure	30.25	-	-	
Astronomy	Day Length	Rise	Set	▲
Actual Time	12h 13m	6:38 AM	6:52 PM	
Civil Twilight		6:10 AM	7:19 PM	
Nautical Twilight		5:38 AM	7:52 PM	
Astronomical Twilight		5:04 AM	8:25 PM	
Moon: waxing gibbous		5:29 PM	3:00 AM	

# Daily Observations

Time	Temperature	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Precip Accum
12:53 AM	83 ° F	67 ° F	58 %	SSW	16 mph	32 mph	29.1 in	0.0 in	0.0 in
1:53 AM	82 ° F	66 ° F	58 %	SSW	16 mph	33 mph	29.1 in	0.0 in	0.0 in
2:53 AM	82 ° F	65 ° F	56 %	SSW	18 mph	29 mph	29.1 in	0.0 in	0.0 in
3:53 AM	81 ° F	65 ° F	58 %	SSW	17 mph	32 mph	29.1 in	0.0 in	0.0 in
4:53 AM	80 ° F	66 ° F	62 %	SW	16 mph	29 mph	29.1 in	0.0 in	0.0 in
5:53 AM	78 ° F	67 ° F	68 %	SSW	13 mph	0 mph	29.1 in	0.0 in	0.0 in
6:53 AM	77 ° F	68 ° F	74 %	SSW	12 mph	0 mph	29.1 in	0.0 in	0.0 in
7:53 AM	76 ° F	68 ° F	76 %	SW	13 mph	21 mph	29.1 in	0.0 in	0.0 in
8:53 AM	76 ° F	62 ° F	62 %	W	18 mph	37 mph	29.2 in	0.0 in	0.0 in
9:53 AM	76 ° F	63 ° F	64 %	WSW	17 mph	31 mph	29.2 in	0.0 in	0.0 in
10:53 AM	76 ° F	62 ° F	62 %	W	14 mph	32 mph	29.2 in	0.0 in	0.0 in
11:53 AM	76 ° F	59 ° F	56 %	W	18 mph	28 mph	29.3 in	0.0 in	0.0 in
12:53 PM	76 ° F	56 ° F	50 %	W	21 mph	30 mph	29.3 in	0.0 in	0.0 in
1:53 PM	74 ° F	52 ° F	46 %	W	16 mph	29 mph	29.3 in	0.0 in	0.0 in
2:53 PM	75 ° F	51 ° F	43 %	WNW	18 mph	29 mph	29.3 in	0.0 in	0.0 in
3:53 PM	73 ° F	51 ° F	46 %	WNW	16 mph	26 mph	29.3 in	0.0 in	0.0 in
4:53 PM	71 ° F	50 ° F	47 %	NW	15 mph	0 mph	29.4 in	0.0 in	0.0 in
5:53 PM	69 ° F	48 ° F	47 %	NW	15 mph	0 mph	29.4 in	0.0 in	0.0 in
6:53 PM	68 ° F	48 ° F	49 %	NNW	16 mph	0 mph	29.4 in	0.0 in	0.0 in
7:53 PM	64 ° F	45 ° F	50 %	NNW	13 mph	24 mph	29.5 in	0.0 in	0.0 in
8:53 PM	63 ° F	45 ° F	52 %	NNW	15 mph	0 mph	29.5 in	0.0 in	0.0 in
9:53 PM	61 ° F	45 ° F	56 %	N	18 mph	26 mph	29.6 in	0.0 in	0.0 in
10:53 PM	59 ° F	41 ° F	51 %	N	9 mph	0 mph	29.6 in	0.0 in	0.0 in
11:53 PM	58 ° F	41 ° F	53 %	N	13 mph	0 mph	29.6 in	0.0 in	0.0 in

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## **APPENDIX G**

### **Testing Equipment Information**



## Pitot Tube Calibration

Probe Type: S-Type Pitot I.D. Number: P-6-4  
Project Number: \_\_\_\_\_

### Thermocouple Calibration

Reference Type: Thermometer Reference I.D. No: 1641582Rg Pyrometer I.D. No: 80512890 Units: °F

Point No.	Target Temp.	Reference Temp.	Indicated Temp.	Temp. Difference	% Difference*	Within spec?
1	Ambient					
2	200°F-250°F					

\* Based on Absolute Temperature (Rankine)

%Difference ≤ 1.5

### Geometric Pitot Calibration

Is pitot assembly in good repair? ☒ Yes ☐ No If no, explain: \_\_\_\_\_

### "S" Pitot

Dimensions	Dimensions	Specifications	Within Spec?
$\alpha 1 = 1.0$	$\alpha 2 = 0.0$	$\leq 10^\circ$	YES
$\beta 1 = 2.0$	$\beta 2 = 2.0$	$\leq 5^\circ$	YES
$\gamma = 0.0$	$\theta = 0.0$	None	N/A
$A = 0.718$		None	N/A
$Dt = 0.250$		$0.1875" \leq Dt \leq 0.375"$	YES

Calculations	Specifications	Within Spec?
$A/2 = Pa = Pb = 0.359 \text{ inches}$	None	N/A
$Pa/Dt = Pb/Dt = 1.436 \text{ inches}$	$1.05 < P/Dt < 1.5$	YES
$z = A \sin \gamma = 0.000 \text{ inches}$	$\leq 0.125"$	YES
$w = A \sin \theta = 0.000 \text{ inches}$	$\leq 0.03125"$	YES

Pitot Cp= 0.84 according to 40 CFR 60 section 10.1

### Standard Pitot

Measurement	Specification	Calculation	Within Spec?
Tube O.D.	None		
Static Hole I.D.	within 10% of (0.1*O.D.)		
Tip to Static	$\geq 6 \times \text{O.D.}$		
Static to Bend	$\geq 8 \times \text{O.D.}$		

Pitot Cp= \_\_\_\_\_

Calibrated by: Wayne Berry

Date: 4/26/2018



## Pitot Tube Calibration

Probe Type: S-Type Pitot I.D. Number: P-4-2  
Project Number: \_\_\_\_\_

### Thermocouple Calibration

Reference Type: Thermometer Reference I.D. No: 1641582Rg Pyrometer I.D. No: 80512890 Units: °F

Point No.	Target Temp.	Reference Temp.	Indicated Temp.	Temp. Difference	% Difference*	Within spec?
1	Ambient					
2	200°F-250°F					

\* Based on Absolute Temperature (Rankine)

%Difference ≤ 1.5

### Geometric Pitot Calibration

Is pitot assembly in good repair? ☒ Yes ☐ No If no, explain:

### "S" Pitot

Dimensions	Dimensions	Specifications	Within Spec?
$\alpha 1 = 1.0$	$\alpha 2 = 1.0$	$\leq 10^\circ$	YES
$\beta 1 = -1.0$	$\beta 2 = 2.0$	$\leq 5^\circ$	YES
$\gamma = 3.0$	$\theta = 0.0$	None	N/A
$A = 0.731$		None	N/A
$Dt = 0.250$		$0.1875" \leq Dt \leq 0.375"$	YES

Calculations	Specifications	Within Spec?
$A/2 = Pa = Pb = 0.366$ inches	None	N/A
$Pa/Dt = Pb/Dt = 1.462$ inches	$1.05 < P/Dt < 1.5$	YES
$z = A \sin \gamma = 0.038$ inches	$\leq 0.125"$	YES
$w = A \sin \theta = 0.000$ inches	$\leq 0.03125"$	YES

Pitot Cp= 0.84 according to 40 CFR 60 section 10.1

### Standard Pitot

Measurement	Specification	Calculation	Within Spec?
Tube O.D. 1.000 inches	None		N/A
Static Hole I.D.	within 10% of (0.1*O.D.)		
Tip to Static	$\geq 6 \times O.D.$		
Static to Bend	$\geq 8 \times O.D.$		

Pitot Cp=

Calibrated by: Wayne Berry

Date: 9/19/2018

**Ulfig, Joseph**

---

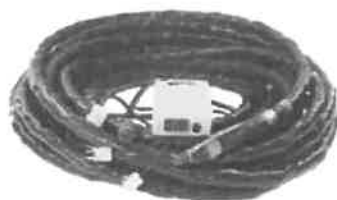
**From:** Bill Graham <bgraham@cleanair.com>  
**Sent:** Wednesday, September 19, 2018 9:52 AM  
**To:** Ulfig, Joseph  
**Subject:** RE: Reference P-50998

Joe,  
here is a cut sheet for heated lines directly from our Express Sales website. Sterigenics currently has one 0723-100 and one 0723-100HD.  
the tubing is the same in both of them.

Regards,

Bill Graham Palatine Rental Team Leader  
CleanAir Instrument Rental  
500 W. Wood St. | Palatine, IL 60067  
O: +1-800-553-5511 | [rental.cleanair.com](http://rental.cleanair.com)

## HEATED SAMPLE LINES



These heated sample lines feature an electrically heat traced and insulated 3/8" Teflon® PTFE (.030 Wall) sample line with a stainless steel over braid and stainless steel tube ends, a 1/4 Teflon® PTFE (.040) calibration line, 3 pin Amphenol power connector, and 2 type K thermocouple plugs. Protected by a durable scuff

resistant extruded polyurethane jacket. \*Temperature controller sold separately. \*These Heated Sample Lines are not self limiting, a temperature controller is required.

### HEATED SAMPLE LINES ARE USED WITH:

- CEM Cateco - 0035RNT
- CEM 3 Point Probe - 0723123
- Temperature Controllers

## HEAVY DUTY VERSUS STANDARD HEATED SAMPLE LINE

- Note: Heavy Duty Heated Sample Lines HD are manufactured to have a continuous operating temperature of 400°F (~204°C) at an ambient temperature of -20°F.
- Note: Standard Heated Sample Lines are manufactured to have a continuous operating temperature of 400°F (~204°C) at an ambient temperature of 0°F.



### HEATED SAMPLE LINE FEATURES:

- Rated for 400 ° F continuous operation at -20 ° F ambient temperature
- Triple insulation maintains temperature of line with less power consumption. (Heavy Duty)
- Lower resistance heaters requires less power to heat lines.
- A backup type K thermocouple to prevent project delays in the case of primary thermocouple failure in the field.
- Stainless steel over braid and stainless steel tube ends for the sample line to prevent abrasive failure in the field. Optional stainless steel over braid for protection of calibration line from abrasive failure in the field.
- Durable extruded poly-urethane jacket for protection of sample/calibration lines from abrasive failure in the field.
- Inert teflon® PTFE sample and calibration lines will provide more accurate results by eliminating potential bias from other materials. Teflon is also more corrosion resistant than tygon, and can be washed with acetone without degradation.

Part Number	Voltage	Watts	Length FT	Amp.
0723-10	120	300	10' Heated Sample Line	2.73
0723-25	120	750	25' Heated Sample Line	6.82
0723-50	120	1500	50' Heated Sample Line	13.64
0723-100	120	2500	100' Heated Sample Line	22.73
0723-100HD	120	3000	100' Heavy Duty Heated Sample Line	27
0723-100220	120/240	N/A	100' Dual Voltage Heated Sample Line	N/A
0725RENT	Universal Temperature Controller			

Custom lengths, voltage, and configuration available\*Heavy Duty Heated Sample Lines are manufactured to have a continuous operating temperature of 400°F (~204°C) at -20°F ambient temperature. These Heated Sample Lines may be rented through [CleanAir Rental](#)





FLIR Commercial Systems, Inc.  
9 Townsend West  
Nashua, NH 03063 USA  
Telephone: 603.324.7600  
1-800-GOINFRA

# Certificate of Compliance

We hereby certify that to the best of our knowledge, the instruments listed below meet or exceed the specifications stated in the appropriate instruction manuals. FLIR Commercial Systems, Inc., an ISO 9001:2008 certified company, inspects its incoming shipments using an approved sampling plan with an AQL. All incoming inspections are performed using test equipment that is traceable to National Standards.

CUSTOMER: ECSI, INC.  
MODEL #: EA10  
SERIAL#: 171103433

Dated this day: 04/03/2018

## **APPENDIX H**

### **Sample Line Residence Time**

#### Sample Line Volume Calculation

Data: 100 ft of 3/8" Teflon line with wall thickness of .030"

Interior Volume Radius: (outside diameter/2) – (wall thickness) = (.375"/2) - .030" = 0.1575"

0.1575" \* 1 ft/12 inches = 0.013125 feet

Cylindrical Volume =  $\pi * r^2 * \text{length}$  = 3.1459 \* (0.013125)<sup>2</sup> \* 1 foot line length = 0.00054193 cubic feet per foot of line

0.00054193 cubic feet \* 28316.8 cc / 1 cubic foot = 15.3457 cc per foot of line

For 100 foot of line, the total interior volume is 1535 cc.

#### Sample Residence Time Calculation

Sample Residence Time = Volume of sample lines / Sample pump flow rate

= 1535 cc / 500-1000 cc per minute = 1.54 - 3.07 minutes



**APPENDIX I**  
**Calibration Data**

# ETHYLENE OXIDE SOURCE TEST/CALIBRATION DATA

Client: sterigenics-Willowbrook 1

Source Tested: AAT safe Cell System

Date: 9/21/18

## PRE CALIBRATION

	Calibration Gas Conc. (ppmv)	1.10 ppm EtO	10.1 ppm EtO	100 ppm EtO	1000 ppm EtO	10080 ppm EtO			
Inlet (FID)	Area Counts #1	<u>397</u>	<u>370</u>	<u>36.0</u>					
	Area Counts #2/3	<u>396</u> <u>395</u>	<u>371</u> <u>369</u>	<u>35.3</u> <u>36.2</u>					
	Average Area	<u>396.0</u>	<u>370.0</u>	<u>35.80</u>			Sample Line Bias Calibration		
	Audit Standard (48.8 ppmv) Result						(Std @ 100 ppmv)		
Outlet (PID)	Calibration Gas Conc. (ppmv) #4	<u>2.73</u>							
	Area Counts #1	<u>274</u>	<u>26.4</u>	<u>250</u>					
	Area Counts #2/3	<u>273</u> <u>275</u>	<u>25.9</u> <u>26.1</u>	<u>254</u> <u>253</u>					
	Average Area	<u>274.0</u>	<u>26.13</u>	<u>252.3</u>			Sample Line Bias Calibration		
	Audit Standard (48.8 ppmv) Result						(Std @ 10.1 ppmv)		

Run #1: 0913 Run #2: 0930 Run #3: 0952  
 BV Start: 0928 BV Stop: 0945 1007

P<sub>bar</sub>: 28.95

EtO Usage (lbs/yr): \_\_\_\_\_

%H<sub>2</sub>O: \_\_\_\_\_

Cycles Per Week: \_\_\_\_\_

## MID/POST CALIBRATION

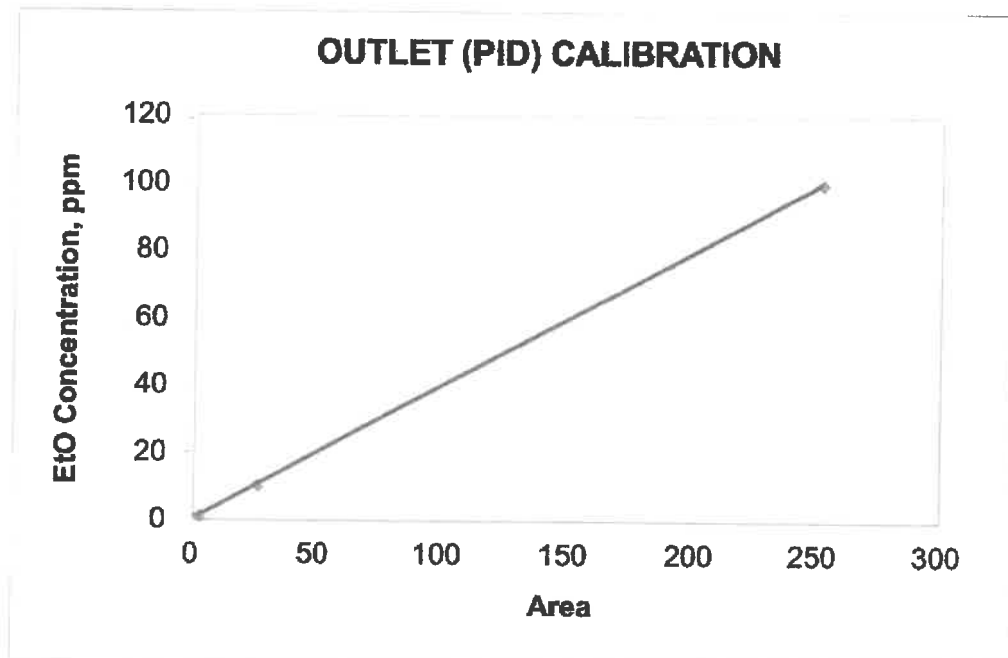
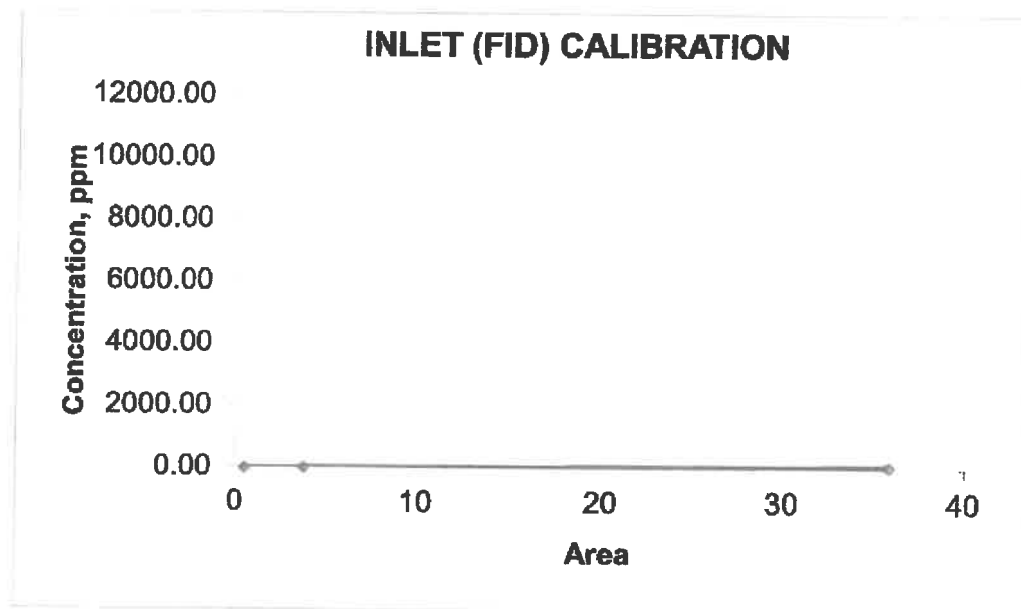
	Calibration Gas Conc. (ppmv)	1.10 ppm EtO	10.1 ppm EtO	100 ppm EtO	1000 ppm EtO	10080 ppm EtO			
Inlet (FID)	<del>Mid Cal</del>								
	Post Cal			<u>36.1 = 99.8</u>	<u>ppm</u>				
	Audit Standard (48.8 ppmv) Result								
Outlet (PID)	Calibration Gas Conc. (ppmv)	1.10 ppm EtO	10.1 ppm EtO	100 ppm EtO					
	<del>Mid Cal</del>								
	Post Cal		<u>25.9 = 10.2</u>	<u>ppm</u>					
	Audit Standard (48.8 ppmv) Result								

*ECSi*

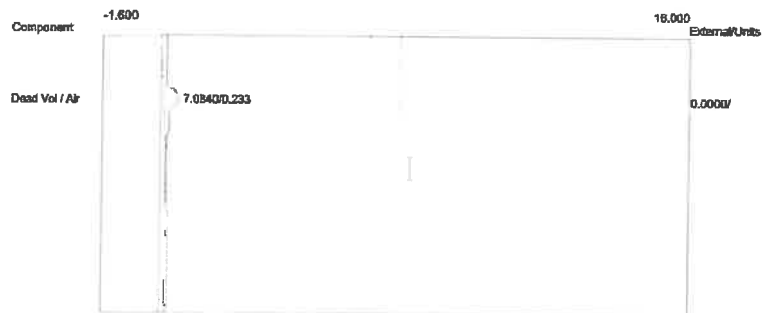
## EtO Calibrations

Site: Sterigenics - Willowbrook 1

Date: 9/21/2018

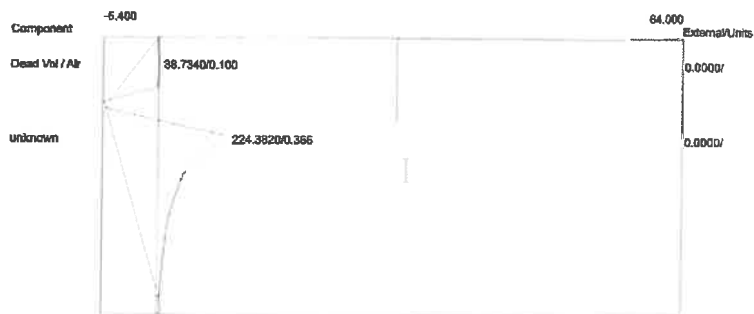


Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:02:52  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carboapak B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-Amb.CHR (c:\peak359)  
 Sample: Ambient Background  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.233	7.0840	0.0000	
		7.0840	0.0000	

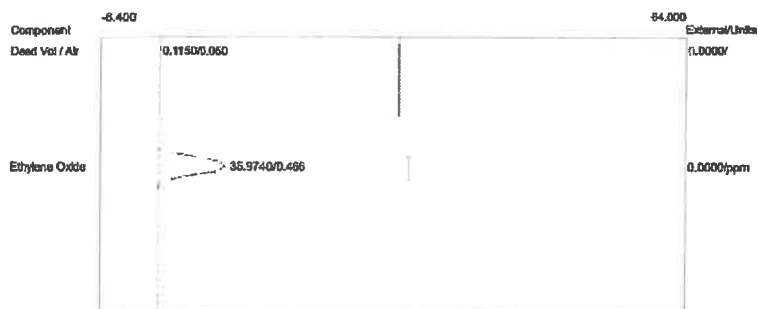
Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:02:52  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carboapak B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-Amb.CHR (c:\peak359)  
 Sample: Ambient Background  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.100	38.7340	0.0000	
		38.7340	0.0000	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:14:01  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carboxack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C01.CHR (c:\peak359)  
 Sample: 100 ppm std  
 Operator: D. Kremer

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:14:01  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carboxack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C01.CHR (c:\peak359)  
 Sample: 100 ppm Std  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.050	0.1150	0.0000	
Ethylene Oxide	0.466	35.9740	0.0000	ppm
		36.0890	0.0000	



Component	Retention	Area	External	Units
Dead Vol / Air	0.066	2.8880	0.0000	
Ethylene Oxide	0.483	250.3980	0.0000	ppm
		253.2860	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:17:09  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C02.CHR (c:\peak359)  
 Sample: 100 ppm std  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:17:09  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C02.CHR (c:\peak359)  
 Sample: 100 ppm Std  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Ethylene Oxide	0.466	35.2280	0.0000	ppm
		35.2280	0.0000	



Component	Retention	Area	External	Units
Dead Vol / Air	0.283	1.1260	0.0000	
Ethylene Oxide	0.500	253.5895	0.0000	ppm
		254.7155	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:19:40  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C03.CHR (c:\peak359)  
 Sample: 100 ppm std  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:19:40  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carboxpack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C03.CHR (c:\peak359)  
 Sample: 100 ppm Std  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.066	0.1230	0.0000	
Ethylene Oxide	0.466	36.2430	0.0000	ppm
		36.3660	0.0000	



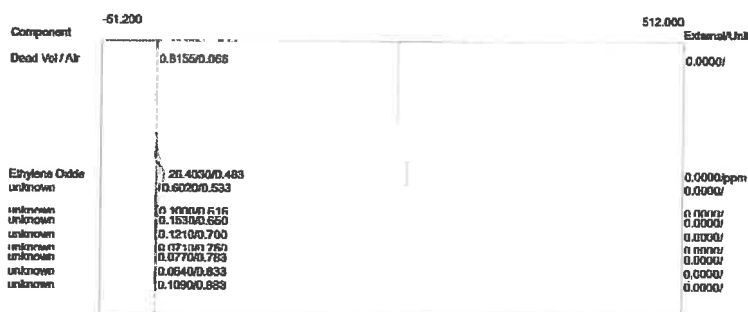
Component	Retention	Area	External	Units
Dead Vol / Air	0.266	1.2750	0.0000	
Ethylene Oxide	0.483	253.1490	0.0000	ppm
		254.4240	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:21:40  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C04.CHR (c:\peak359)  
 Sample: 10.1 ppm std  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:21:40  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C04.CHR (c:\peak359)  
 Sample: 10.1 ppm std  
 Operator: D. Kremer



Component	Retention	Area	External Units
Ethylene Oxide	0.466	3.6950	0.0000 ppm
		3.6950	0.0000



Component	Retention	Area	External Units
Dead Vol / Air	0.066	0.8155	0.0000
Ethylene Oxide	0.483	26.4030	0.0000 ppm
		27.2185	0.0000

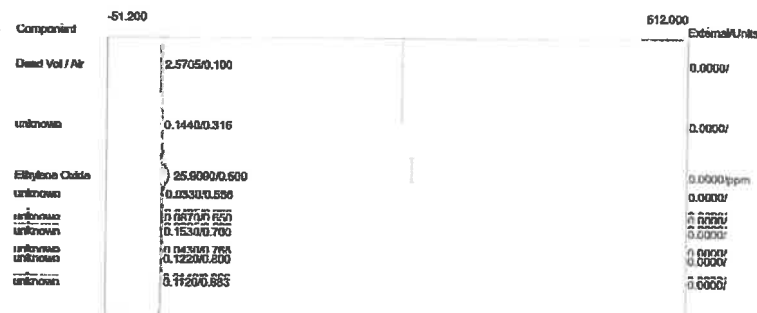


Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:26:02  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carboxack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C05.CHR (c:\peak359)  
 Sample: 10.1 ppm std  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:26:02  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carboxack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C05.CHR (c:\peak359)  
 Sample: 10.1 ppm std  
 Operator: D. Kremer



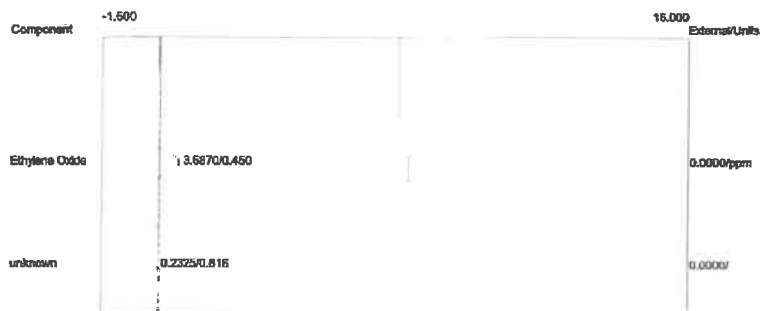
Component	Retention	Area	External Units
Ethylene Oxide	0.466	3.7130	0.0000 ppm
		3.7130	0.0000



Component	Retention	Area	External Units
Dead Vol / Air	0.100	2.5705	0.0000
Ethylene Oxide	0.500	25.9090	0.0000 ppm
		28.4795	0.0000

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:30:06  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C06.CHR (c:\peak359)  
 Sample: 10.1 ppm std  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:30:06  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C06.CHR (c:\peak359)  
 Sample: 10.1 ppm std  
 Operator: D. Kremer

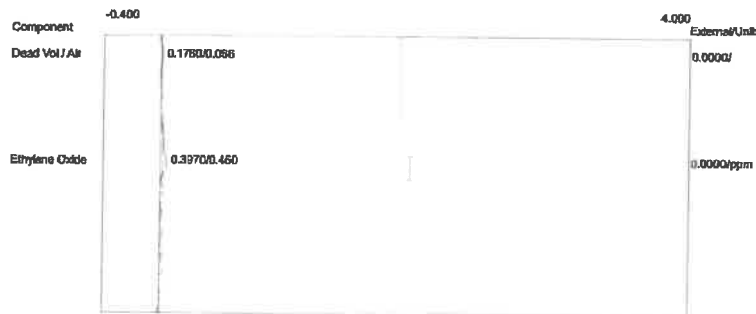


Component	Retention	Area	External	Units
Ethylene Oxide	0.450	3.6870	0.0000	ppm
		3.6870	0.0000	



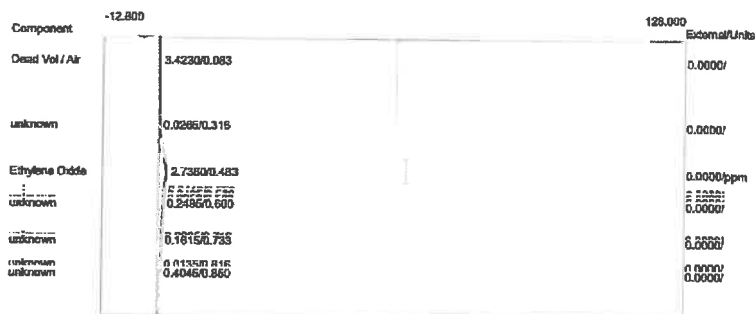
Component	Retention	Area	External	Units
Dead Vol / Air	0.066	4.9475	0.0000	
Ethylene Oxide	0.483	26.0620	0.0000	ppm
		31.0095	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:35:21  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C07.CHR (c:\peak359)  
 Sample: 40-4 ppm std 1.10  
 Operator: D. Kramer



Component	Retention	Area	External	Units
Dead Vol / Air	0.066	0.1780	0.0000	
Ethylene Oxide	0.450	0.3970	0.0000	ppm
		0.5750	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:35:21  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C07.CHR (c:\peak359)  
 Sample: 40-4 ppm std 1.10  
 Operator: D. Kramer



Component	Retention	Area	External	Units
Dead Vol / Air	0.083	3.4230	0.0000	
Ethylene Oxide	0.483	2.7380	0.0000	ppm
		6.1610	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:42:38  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C08.CHR (c:\peak359)  
 Sample: ~~10~~-1 ppm std 1.10  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:42:38  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C08.CHR (c:\peak359)  
 Sample: ~~10~~-1 ppm std 1.10  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.083	0.3760	0.0000	
Ethylene Oxide	0.466	0.3955	0.0000	ppm
	0.7715	0.0000		



Component	Retention	Area	External	Units
Dead Vol / Air	0.083	3.3910	0.0000	
Ethylene Oxide	0.500	2.7285	0.0000	ppm
		6.1195	0.0000	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:52:32  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbo-pack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C09.CHR (c:\peak359)  
 Sample: 10-1 ppm std 1.10  
 Operator: D. Kremer

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:52:32  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbo-pack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C09.CHR (c:\peak359)  
 Sample: 10-1 ppm std 1.10  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.100	0.1280	0.0000	
Ethylene Oxide	0.466	0.3945	0.0000	ppm
		0.5225	0.0000	



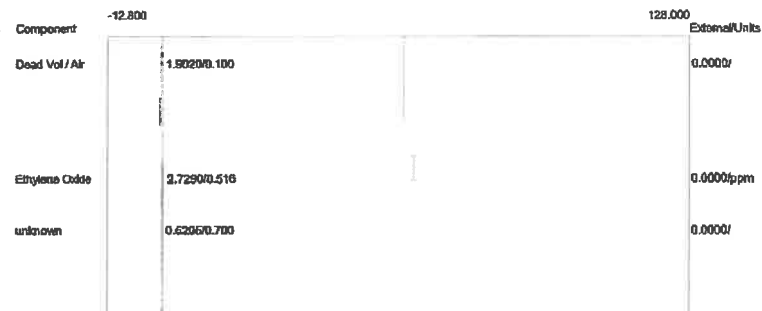
Component	Retention	Area	External	Units
Dead Vol / Air	0.083	2.8105	0.0000	
Ethylene Oxide	0.500	2.7540	0.0000	ppm
		5.5645	0.0000	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:59:13  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-4C.CHR (c:\peak359)  
 Sample: 40-1 ppm std 1.10  
 Operator: D. Kremer

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 05:59:13  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-4C.CHR (c:\peak359)  
 Sample: 40-1 ppm std 1.10  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.083	0.5210	0.0000	
Ethylene Oxide	0.483	0.4020	0.0000	ppm
		0.9230	0.0000	



Component	Retention	Area	External	Units
Dead Vol / Air	0.100	1.9020	0.0000	
Ethylene Oxide	0.516	2.7290	0.0000	ppm
		4.6310	0.0000	

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 06:08:35  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-Audit.CHR (c:\peak359)  
 Sample: 48.8 ppm audit std  
 Operator: D. Kremer

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 06:08:35  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-Audit.CHR (c:\peak359)  
 Sample: 48.8 ppm audit std  
 Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.050	0.1105	0.0000
Ethylene Oxide	0.466	17.4080	48.1622 ppm
		17.5185	48.1622



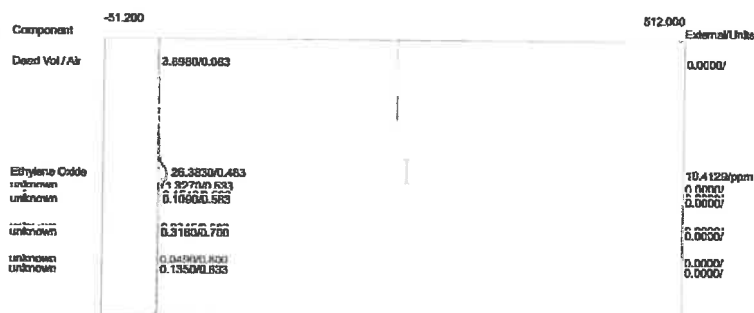
Component	Retention	Area	External Units
Dead Vol / Air	0.066	0.9790	0.0000
Ethylene Oxide	0.483	122.7760	48.4576 ppm
		123.7550	48.4576

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 06:15:37  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C10.CHR (c:\peak359)  
 Sample: 100 ppm std sample line bias  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.066	0.4660	0.0000	
Ethylene Oxide	0.466	35.8985	99.3192	ppm
		36.3645	99.3192	

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PreCal  
 Analysis date: 09/21/2018 06:20:23  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, CarboPack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C11.CHR (c:\peak359)  
 Sample: 10.1 ppm std sample line bias  
 Operator: D. Kremer

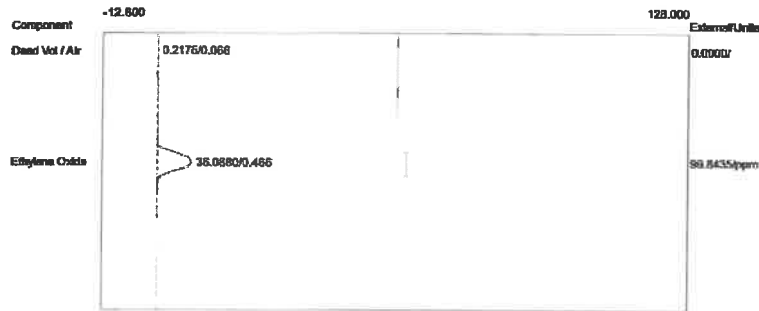


Component	Retention	Area	External	Units
Dead Vol / Air	0.083	3.8980	0.0000	
Ethylene Oxide	0.483	26.3830	10.4129	ppm
		30.2810	10.4129	

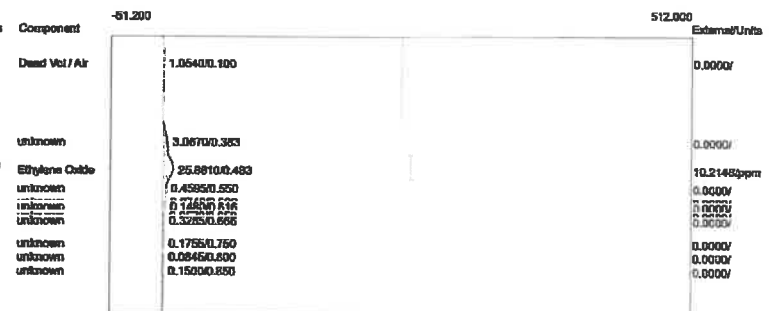


Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PostCal  
 Analysis date: 09/21/2018 11:01:28  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1Ster1WB2018-C11.CHR (c:\peak359)  
 Sample: 100 ppm std  
 Operator: D. Kremer

Lab name: ECSI  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PostCal  
 Analysis date: 09/21/2018 11:06:36  
 Method: Direct Injection  
 Description: CHANNEL 2 - PID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto2-100.cpt  
 Data file: 2Ster1WB2018-C12.CHR (c:\peak359)  
 Sample: 10.1 ppm std  
 Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.066	0.2175	0.0000
Ethylene Oxide	0.466	36.0880	99.8435 ppm
		36.3055	99.8435



Component	Retention	Area	External Units
Dead Vol / Air	0.100	1.0540	0.0000
Ethylene Oxide	0.483	25.8810	10.2148 ppm
		26.9350	10.2148

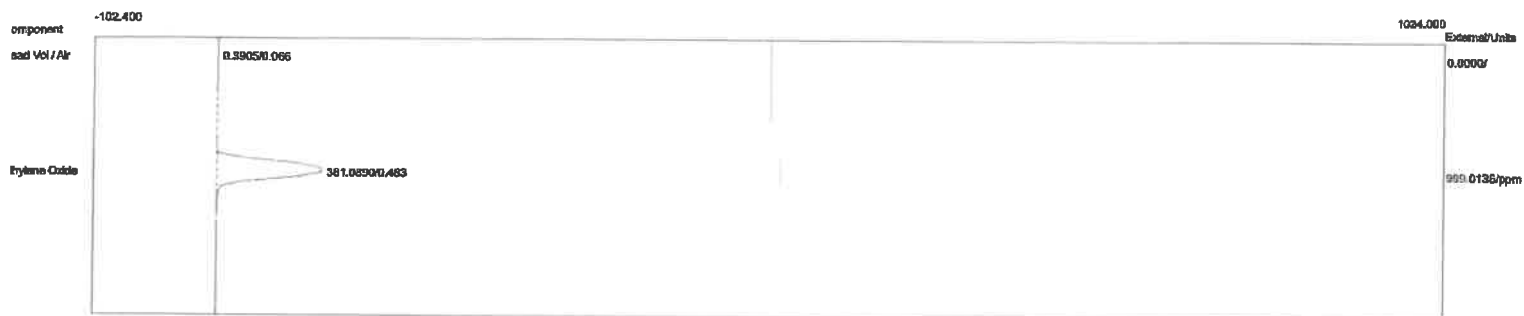
Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PostCal  
 Analysis date: 09/24/2018 19:35:07  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1SterWB2018-C01.CHR (c:\peak359)  
 Sample: 1000 ppm std  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Ethylene Oxide	0.500	360.7670	998.1227	ppm
		360.7670	998.1227	

\* 1000 ppm std run post-test using calibration curve  
 from test to demonstrate linearity @ 100-1000 ppm,  
 this chromatogram is 1/3

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PostCal  
 Analysis date: 09/24/2018 19:37:34  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1SterWB2018-C02.CHR (c:\peak359)  
 Sample: 1000 ppm std  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Lead Vol / Air	0.066	0.3905	0.0000	
Ethylene Oxide	0.483	361.0890	999.0136	ppm
		361.4795	999.0136	

2/3

Lab name: ECSi  
 Client: Sterigenics - Willowbrook 1  
 Client ID: PostCal  
 Analysis date: 09/24/2018 19:39:26  
 Method: Direct Injection  
 Description: CHANNEL 1 - FID  
 Column: 1% SP-1000, Carbopack B  
 Carrier: HELIUM  
 Temp. prog: eto-100.tem  
 Components: eto1-100.cpt  
 Data file: 1SterWB2018-C03.CHR (c:\peak359)  
 Sample: 1000 ppm std  
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.066	0.5490	0.0000	
Ethylene Oxide	0.483	360.7760	998.1476	ppm
		361.3250	998.1476	

3/3

**APPENDIX J**  
**Gas Certifications**



**Scott Specialty Gases**

500 CAJON BLVD., SAN BERNARDINO, CA 92411

**CERTIFIED WORKING CLASS**

*Single-Certified Calibration Standard*

Phone: 909-887-2571 Fax: 909-887-0549

**CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard**

**Product Information**

Project No.: 02-57164-001  
Item No.: 02020001310TCL  
P.O. No.: VBL-D. KREMER

Cylinder Number: CAL4448  
Cylinder Size: CL  
Certification Date: 20Apr2018

**Customer**

ECSI, INC  
PO BOX 1498  
SAN CLEMENTE, CA 92674

**CERTIFIED CONCENTRATION**

**Component Name**

ETHYLENE OXIDE  
NITROGEN

**Concentration  
(Moles)**

1.10 PPM  
BALANCE

**Accuracy  
(+/-%)**

5

**TRACEABILITY**

**Traceable To**

Scott Reference Standard

APPROVED BY:

MT

DATE: 4-20-18

## **SPECIFICATIONS**

<b>Component Name</b>	<b>Requested Concentration (Moles)</b>	<b>Certified Concentration (Moles)</b>	<b>Blend Tolerance Result (+/- %)</b>	<b>Certified Accuracy Result (+/- %)</b>
ETHYLENE OXIDE NITROGEN	1. PPM BAL	1.10 PPM BAL	10.0	5.00

## **TRACEABILITY**

**Traceable To**  
Scott Reference Standard

## **PHYSICAL PROPERTIES**

Cylinder Size: CL                      Pressure: 1200 PSIG  
Expiration Date: 20Apr2020

## **SPECIAL HANDLING INSTRUCTIONS**

Do not use or store cylinder at or below the stated dew point temperature. Possible condensation of heavier components could result. In the event the cylinder has been exposed to temperatures at or below the dew point, place cylinder in heated area for 24 hours and then roll cylinder for 15 minutes to re-mix.

Use of calibration standards at or below dew point temperature may result in calibration error.

## **COMMENTS**



Scott Specialty Gases

100 CAJON BLVD., SAN BERNARDINO, CA 92411

**CERTIFIED WORKING CLASS**

*Single-Certified Calibration Standard*

Phone: 909-887-2571 Fax: 909-887-0549

**CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard**

**Product Information**

Project No.: 02-57164-003  
Item No.: 02020001320TCL  
P.O. No.: VBL - D. KREMER

Cylinder Number: CLM003232  
Cylinder Size: CL  
Certification Date: 20Apr2018

**Customer**

ECSI, INC  
PO BOX 1498  
SAN CLEMENTE, CA 92674

**CERTIFIED CONCENTRATION**

**Component Name**

**Concentration  
(Moles)**

**Accuracy  
(+/-%)**

ETHYLENE OXIDE  
NITROGEN

10.1 PPM  
BALANCE

5

**TRACEABILITY**

**Traceable To**

Scott Reference Standard

APPROVED BY:

MT

DATE:

4-20-18



## **SPECIFICATIONS**

<b>Component Name</b>	<b>Requested Concentration (Moles)</b>		<b>Certified Concentration (Moles)</b>		<b>Blend Tolerance Result (+/- %)</b>	<b>Certified Accuracy Result (+/- %)</b>
<b>Ethylene Oxide Nitrogen</b>	<b>10.</b>	<b>PEM BAL</b>	<b>10.1</b>	<b>PEM BAL</b>	<b>1.0</b>	<b>5.00</b>

## **TRACEABILITY**

**Traceable To**  
Scott Reference Standard

## **PHYSICAL PROPERTIES**

Cylinder Size: CL

Pressure: 1200 PSIG  
Expiration Date: 20Apr2020

## **SPECIAL HANDLING INSTRUCTIONS**

Do not use or store cylinder at or below the stated dew point temperature. Possible condensation of heavier components could result. In the event the cylinder has been exposed to temperatures at or below the dew point, place cylinder in heated area for 24 hours and then roll cylinder for 15 minutes to re-mix.

Use of calibration standards at or below dew point temperature may result in calibration error.

## **COMMENTS**



Scott Specialty Gases

100 CAJON BLVD., SAN BERNARDINO, CA 92411

**CERTIFIED WORKING CLASS**

*Single-Certified Calibration Standard*

Phone: 909-887-2571 Fax: 909-887-0549

**CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard**

**Product Information**

Project No.: 02-57164-004  
Item No.: 02020001330TCL  
P.O. No.: VBL - D. KREMER

Cylinder Number: CLM011385  
Cylinder Size: CL  
Certification Date: 20Apr2018

**Customer**

ECSI, INC  
PO BOX 1498  
SAN CLEMENTE, CA 92674

**CERTIFIED CONCENTRATION**

**Component Name**

**Concentration  
(Moles)**

**Accuracy  
(+/-%)**

ETHYLENE OXIDE  
NITROGEN

100. PPM  
BALANCE

5

**TRACEABILITY**

**Traceable To**

Scott Reference Standard

APPROVED BY:

*B. McCall*  
BLM

DATE: 4-20-18

## **SPECIFICATIONS**

<b>Component Name</b>	<b>Requested Concentration (Moles)</b>		<b>Certified Concentration (Moles)</b>		<b>Blend Tolerance Result (+/- %)</b>	<b>Certified Accuracy Result (+/- %)</b>
ETHYLENE OXIDE NITROGEN	100.	FEM BAL	100.	FEM BAL	.0	5.00

## **TRACEABILITY**

Traceable To  
Scott Reference Standard

## **PHYSICAL PROPERTIES**

Cylinder Size: CL

Pressure: 1300 PSIG  
Expiration Date: 20Apr2020

Valve Connection: CGA 350

## **SPECIAL HANDLING INSTRUCTIONS**

Do not use or store cylinder at or below the stated dew point temperature. Possible condensation of heavier components could result. In the event the cylinder has been exposed to temperatures at or below the dew point, place cylinder in heated area for 24 hours and then roll cylinder for 15 minutes to re-mix.

Use of calibration standards at or below dew point temperature may result in calibration error.

## **COMMENTS**



Scott Specialty Gases

500 CAJON BLVD., SAN BERNARDINO, CA 92411

**CERTIFIED WORKING CLASS**

*Single-Certified Calibration Standard*

Phone: 909-887-2571 Fax: 909-887-0549

**CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard**

**Product Information**

Project No.: 02-57164-005  
Item No.: 02020001340TCL  
P.O. No.: VBL - D. KREMER

Cylinder Number: CLM002810  
Cylinder Size: CL  
Certification Date: 20Apr2018

**Customer**

ECSI, INC  
PO BOX 1488  
SAN CLEMENTE, CA 92674

**CERTIFIED CONCENTRATION**

**Component Name**

ETHYLENE OXIDE  
NITROGEN

**Concentration  
(Moles)**

1,000. PPM  
BALANCE

**Accuracy  
(+/-%)**

5

**TRACEABILITY**

**Traceable To**

Scott Reference Standard

APPROVED BY:

BLM

DATE: 4-20-18

## **SPECIFICATIONS**

<b>Component Name</b>	<b>Requested Concentration (Moles)</b>	<b>Certified Concentration (Moles)</b>	<b>Blend Tolerance Result (+/- %)</b>	<b>Certified Accuracy Result (+/- %)</b>
ETHYLENE OXIDE NITROGEN	1,000. PPM BAL	1,000. PPM BAL	.0	5.00

## **TRACEABILITY**

Traceable To  
Scott Reference Standard

## **PHYSICAL PROPERTIES**

Cylinder Size: CL

Pressure: 1200 PSIG  
Expiration Date: 20Apr2020

Valve Connection: CGA 350

## **SPECIAL HANDLING INSTRUCTIONS**

Do not use or store cylinder at or below the stated dew point temperature. Possible condensation of heavier components could result. In the event the cylinder has been exposed to temperatures at or below the dew point, place cylinder in heated area for 24 hours and then roll cylinder for 15 minutes to re-mix.

Use of calibration standards at or below dew point temperature may result in calibration error.

## **COMMENTS**



Scott Specialty Gases

100 CAJON BLVD., SAN BERNARDINO, CA 92411

**CERTIFIED WORKING CLASS**

*Single-Certified Calibration Standard*

Phone: 909-887-2571 Fax: 909-887-0549

**CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard**

**Product Information**

Project No.: 02-57164-006

Item No.: 02020001340TCL

P.O. No.: VBL - D. KREMER

Cylinder Number: CLM005787

Cylinder Size: CL

Certification Date: 20Apr2018

**Customer**

ECSI, INC

PO BOX 1498

SAN CLEMENTE, CA 92674

**CERTIFIED CONCENTRATION**

**Component Name**

**Concentration  
(Moles)**

**Accuracy  
(+/-%)**

ETHYLENE OXIDE  
NITROGEN

10,080. PPM  
BALANCE

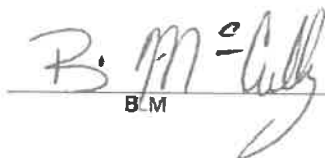
5

**TRACEABILITY**

**Traceable To**

Scott Reference Standard

APPROVED BY:

  
B.M.

DATE: 4-20-18

## **SPECIFICATIONS**

<b>Component Name</b>	<b>Requested Concentration (Moles)</b>	<b>Certified Concentration (Moles)</b>	<b>Blend Tolerance Result (+/- %)</b>	<b>Certified Accuracy Result (+/- %)</b>
<b>ETHYLENE OXIDE</b> <b>NITROGEN</b>	10,000.	PFM BAL	10,080.	PFM BAL
			.8	5.00

## **TRACEABILITY**

**Traceable To**  
Scott Reference Standard

## **PHYSICAL PROPERTIES**

Cylinder Size: CL

Pressure: 700 PSIG  
Expiration Date: 20Apr2020

Valve Connection: CGA 350

## **SPECIAL HANDLING INSTRUCTIONS**

Do not use or store cylinder at or below the stated dew point temperature. Possible condensation of heavier components could result. In the event the cylinder has been exposed to temperatures at or below the dew point, place cylinder in heated area for 24 hours and then roll cylinder for 15 minutes to re-mix.

Use of calibration standards at or below dew point temperature may result in calibration error.

## **COMMENTS**

**MESA****CERTIFICATE OF ANALYSIS**

<b>Customer Name:</b>	ECSi, Inc.	<b>Cylinder Number:</b>	SA25925
<b>Stock or Analyzer Tag Number:</b>	N/A	<b>Product Class:</b>	Certified Standard
<b>Customer Reference:</b>	Verbal- Dan	<b>Cylinder - Contents<sup>1</sup>:</b>	28 CF @ 2000 PSI
<b>MESA Reference:</b>	104448	<b>Cylinder-CGA:</b>	A006-HP-BR/350
<b>Date of Certification:</b>	4/19/2018	<b>Analysis Method:</b>	GC-TCD/FID
<b>Recommended Shelf Life:</b>	2 Years	<b>Preparation Method:</b>	Gravimetric

<b>Component</b>	<b>Requested Concentration<sup>2</sup></b>	<b>Reported Concentration<sup>2,3</sup></b>
Ethylene Oxide	50 ppm	48.8 ppm
Nitrogen	Balance	Balance

**Authorized Signature:**

1. The fill pressure shown on the COA is as originally quoted. The fill pressure measured by the customer may differ from the fill pressure originally quoted due to temperature effects, compressibility of the individual components when blended together in the cylinder, gauge accuracy or reduction in content volume before shipping as a result of samples withdrawn for laboratory QC necessary to ensure product quality.
2. Unless otherwise stated, concentrations are given in molar units.
3. Vapor pressure mixes are blended at a sufficiently low pressure so as to eliminate phase separation under most low temperature conditions encountered during transport or storage. However, it is generally recommended that cylinders containing vapor pressure restricted mixes be placed on the floor in a horizontal position and rolled back and forth to improve homogeneity of the gas phase mixture before being put into service.

Analytical Gas Standards are prepared and analyzed using combinations of NIST traceable weights, SRM's provided by NIST, or internal gas standards that have been verified for accuracy using procedures published by the US-EPA. Pure gases are analyzed and certified for purity using minor component Analytical Gas Standards prepared according to the methods specified above. Balances are calibrated to NIST test weights covered by NIST test number 822/256175/96. Reference Certification #'s: 163/W, 830/N and 3280. Calibration methods are in conformance with MIL-STD 45662A.

**MESA Specialty Gases & Equipment**

division of MESA International Technologies, Inc.  
3619 Pendleton Avenue, Suite C • Santa Ana, California 92704 • USA  
TEL: 714-434-7102 • FAX: 714-434-8006 • E-mail: [mail@mesagas.com](mailto:mail@mesagas.com)  
On-line Catalog at [www.mesagas.com](http://www.mesagas.com)



**APPENDIX K**  
**Limit of Detection**

## Detection Limit Study

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**Step 1 : Prepare and analyze at least seven standards prepared at or near the estimated detection limit**

**Step 2 : Record and calculate the standard deviation of the replicate measurements.**

Analysis Number	1	2	3	4	5	6	7	8	9	10
Result	1.007	1.011	1.015	1.01	1.071	1.071	1.067			

Calculated Standard Deviation      =      0.0316

**Step 3 : Determine the Method Detection Limit (MDL) by multiplying the student T value appropriate for 99% confidence level and the standard deviation estimate with in n-1 degrees of freedom**

Number of Replicates	7	8	9	10
T-values	3.143	2.998	2.896	2.821

Method Detection Limit:      =      0.10

## Wagner, Kevin

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**From:** Hoffman, Kathy  
**Sent:** Tuesday, September 25, 2018 8:42 AM  
**To:** Wagner, Kevin  
**Subject:** FW: MDL calculations and additional information.  
**Attachments:** Detection Limit Master Spreadsheet.xls

---

**From:** Shappley, Ned [<mailto:Shappley.Ned@epa.gov>]  
**Sent:** Monday, September 24, 2018 12:02 PM  
**To:** Hoffman, Kathy; [dankremer@ecsi1.com](mailto:dankremer@ecsi1.com)  
**Cc:** Sieffert, Margaret; Mattison, Kevin; Merrill, Raymond; Johnson, Steffan  
**Subject:** MDL calculations and additional information.

Dan/Kathy,

As we discussed on site, attached is the spreadsheet (Note, this is not an official EPA spreadsheet) I used to determine the MDL (i.e., LOD) for the testing last week at Sterigenics. It is important to include all raw data associated with this study as well as a discussion of the procedures used. The reference for how MDL studies should be performed can be found in Section 15.2 of Method 301 (40 CFR Part 63), which links you to 40 CFR Part 136, Appendix B (see below). In this instance, I am making the recommendation to Illinois EPA to accept this MDL study with just spiked samples and collected over a shorter time period.

Based on the 7 replicate values I calculated using the low calibration response, in lieu of reporting a ND, you should report a <0.10 ppm for the measured concentration. It is important to use this MDL value when calculating the DRE. Going forward you should consider repeating the MDL for each test program or include a MDL verification step to ensure that your system is capable of measuring at these low-levels. For future MDL studies, it is strongly suggested you develop an MDL using a similar matrix (i.e., in air) as opposed to a calibration gas cylinder. I suggest filling a Tedlar bag with carbon-free air and injecting a concentration of EtO into the bag targeting a concentration in the Tedlar Bag of approximately 0.3 to 0.5 ppm. This type of evaluation would best replicate the sample matrix as measured by the GC.

### Additional Information:

Going forward, it is important to use the procedures that were utilized during the Sterigenics for future tests, making sure to 1) verify the sampling testing locations meet all Method 1 criteria, 2) performing all required velocity traverses as required by the method, 3) use of heated sampling system (Method 18 – Section 8.2.2.1.1 and 8.2.2.1.2) to prevent moisture or organic condensation, 4) perform a successful recovery study for direct interface sampling (Method 18 – Section 8.4.1) to verify the efficacy of the sampling system, and 5) to select calibration standards that bracket the sample concentrations (Method 18 – Section 8.2.4.3). These are not recommendations, they are requirements of the method and failure to follow these procedures could be grounds for a regulatory authority to invalidate a test.

Please let me know if you have any questions,

Ned Shappley

40 CFR Part 136, Appendix B

....

(a) Select a spiking level, typically 2—10 times the estimated MDL in Section 1. Spiking levels in excess of 10 times the estimated detection limit may be required for analytes with very poor recovery (e.g., for an analyte with 10% recovery, spiked at 100 micrograms/L, with mean recovery of 10 micrograms/L; the calculated MDL may be around 3 micrograms/L. Therefore, in this example, the spiking level would be 33 times the MDL, but spiking lower may result in no recovery at all).

(b) Process a minimum of seven spiked samples and seven method blank samples through all steps of the method. The samples used for the MDL must be prepared in at least three batches on three separate calendar dates and analyzed on three separate calendar dates. (Preparation and analysis may be on the same day.) Existing data may be used, if compliant with the requirements for at least three batches, and generated within the last twenty four months. The most recent available data for method blanks and spiked samples must be used. Statistical outlier removal procedures should not be used to remove data for the initial MDL determination, since the total number of observations is small and the purpose of the MDL procedure is to capture routine method variability. However, documented instances of gross failures (e.g., instrument malfunctions, mislabeled samples, cracked vials) may be excluded from the calculations, provided that at least seven spiked samples and seven method blanks are available. (The rationale for removal of specific outliers must be documented and maintained on file with the results of the MDL determination.)

.....

(ii) Compute the  $MDL_s$  (the MDL based on spiked samples) as follows:

$$MDL_s = t_{(n-1, 1-\alpha = 0.99)} S_s$$

Where:

$MDL_s$  = the method detection limit based on spiked samples

$t_{(n-1, 1-\alpha = 0.99)}$  = the Student's t-value appropriate for a single-tailed 99th percentile t statistic and a standard deviation estimate with n-1 degrees of freedom. See Addendum Table 1.

$S_s$  = sample standard deviation of the replicate spiked sample analyses.

Ned Shappley | USEPA|OAQPS|AQAD|Measurement Technology Group  
109 TW Alexander Drive (E143-02) | Research Triangle Park, NC 27711  
email: [shappley.ned@epa.gov](mailto:shappley.ned@epa.gov) | Phone (919)541-7903

**APPENDIX L**  
**Permits/Protocols**



# ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-3397

BRUCE RAUNER, GOVERNOR

ALEC MESSINA, DIRECTOR

217/785-1705

## CONSTRUCTION PERMIT NESHAP SOURCE

### PERMITTEE

Sterigenics US, LLC  
Attn: Laura Hartman, EHS Manager  
2015 Spring Road, Suite 650  
Oak Brook, Illinois 60523

Application No.: 18060020

I.D. No.: 043110AAC

Applicant's Designation:

Date Received: June 11, 2018

Subject: Control of the Backvents of the Sterilization Chambers

Date Issued: June 26, 2018

Location: 7775 Quincy and 830 Midway, Willowbrook, DuPage County

This Permit is hereby granted to the above-designated Permittee to CONSTRUCT emission source(s) and/or air pollution control equipment consisting of control of the backvents of the sterilization chambers, as described in the above-referenced application. This Permit is subject to standard conditions attached hereto and the following special condition(s):

### 1. Introduction

- a. This permit authorizes control of the existing backvents of the five sterilization chambers (SC-1, SC-2, SC-3, SC-4 and SC-5) at Sterigenic's Willowbrook facilities using the existing control systems that control emissions of ethylene oxide from the vacuum pumps and from aeration.
- b. This permit does not authorize changes to the sterilization chambers or other emission units at the source that would increase their capacity or emissions.
- c. For purposes of this permit, the existing sterilization chambers after their backvents are also connected to control systems are referred to as the "affected units."

### 2. Existing Requirements

This permit does alter established requirements for the affected units, (i.e., applicable emission standards and requirements for testing, monitoring, recordkeeping and reporting), as identified in Sections 4.1 and 4.2 of the Clean Air Act Permit Program (CAAPP) permit for the source, Permit No. 95120085, issued June 8, 2015. In particular, the affected units will continue to be subject to federal National Emission Standards for Hazardous Air Pollutants (NESHAP) for Ethylene Oxide Emissions from Sterilization Facilities, 40 CFR 63 Subpart O.

### 3. Non-applicability Provisions

This permit is issued based on this project not constituting a major modification for purposes of the state rules for Major Stationary Sources Construction and Modification (MSSCAM), 35 IAC Part 203. This is because this project is an emission reduction project that will reduce emissions of volatile organic material.

4. Good Air Pollution Control Practices

At all times, the Permittee shall maintain and operate the affected units and associated air pollution control systems in a manner consistent with good air pollution control practices for minimizing emissions.

5. Notification

The Permittee shall notify the Illinois EPA within 30 days after completion of this project. This notification shall include the date that the backvent on each affected unit is first controlled.

6. Testing

- a. Within 180 days of completion of this project, for the affected units, the Permittee shall perform performance testing in accordance with 40 CFR 63.365 and 63.7. The Permittee shall submit applicable notifications and reports for this testing as required by 40 CFR 63.7, 63.360, 63.365 and 63.366.
- b. The following USEPA methods and procedures shall be used for testing, unless another USEPA method is approved by the Illinois EPA:

Flowrate	Method 2, 2A, 2B, 2C or 2D
Oxygen (O <sub>2</sub> )/Carbon Dioxide (CO <sub>2</sub> )	Method 3A or 3B
Moisture	Method 4 or 320
Ethylene Oxide/Propylene Oxide	Method 18 or 320
- c. The Permittee shall submit a written test plan to the Illinois EPA for this testing and if a significant change in the procedures for this testing is planned from the procedures followed in the previous test. This plan shall be submitted at least 30 days prior to the actual date of testing and include the following information as a minimum:
  - i. A description of the planned test procedures.
  - ii. The person(s) who will be performing sampling and analysis and their experience with similar tests.
  - iii. The specific conditions under which testing will be performed, including a discussion of why these conditions will be representative of maximum emissions and the means or manner by which the operating parameters for the emission unit and any control equipment will be determined.

- iv. The specific determinations of emissions and operation that are intended to be made, including sampling and monitoring locations.
  - v. The test method(s) that will be used, with the specific analysis method, if the method can be used with different analysis methods.
- d. The Permittee shall notify the Illinois EPA prior to conducting these measurements to enable the Illinois EPA to observe testing. Notification for the expected date of testing shall be submitted a minimum of 30 days prior to the expected date. Notification of the actual date and expected time of testing shall be submitted a minimum of 5 working days prior to the actual date of the test. The Illinois EPA may accept shorter advance notice if it does not interfere with the Illinois EPA's ability to observe testing.
- e. Copies of the Final Report(s) for these tests shall be submitted to the Illinois EPA within 30 days after the test results are compiled and finalized but no later than 60 days after completion of sampling. The Final Report shall include as a minimum:
- i. General information, i.e., date of test, names of testing personnel, and names of Illinois EPA observers.
  - ii. A summary of results, e.g., VOM emissions, pounds.
  - iii. A detailed description of operating conditions of the emission unit(s) during testing, including:
    - A. Process information, i.e., mode(s) of operation, process rate, e.g. fuel or raw material consumption.
    - B. Control equipment information, i.e., equipment condition and operating parameters during testing.
    - C. A discussion of any preparatory actions taken, i.e., inspections, maintenance and repair.
  - iv. Description of test method(s), including description of sampling points, sampling train, analysis equipment, and test schedule.
  - v. Data and calculations, including copies of all raw data sheets and records of laboratory analyses, sample calculations, and data on equipment calibration.
  - vi. Conclusions.
- f. The Permittee shall retain copies of emission test reports for at least three years beyond the date that an emission test is superseded by a more recent test.

7. Authorization to Operate



The Permittee may operate the affected units with backvents ducted to the existing control systems pursuant to this construction permit until the CAAPP permit for the source is revised to address this project. This condition supersedes Standard Condition 6.

Please note that the Illinois EPA has not acted in this permit on Sterigenic's request for enforceable limits on the operation and emissions of its Willowbrook facilities so that this source is not a major source under relevant air pollution control regulations. The Illinois EPA is processing that request as a separate application.

If you have any questions on this permit, please contact Daniel Rowell at 217/558-4368.



Raymond E. Pilapil  
Manager, Permit Section  
Bureau of Air

REP:DBR:jlp

*DBR*  
6/24/8



STATE OF ILLINOIS  
ENVIRONMENTAL PROTECTION AGENCY  
DIVISION OF AIR POLLUTION CONTROL  
P. O. BOX 19506  
SPRINGFIELD, ILLINOIS 62794-9506

**STANDARD CONDITIONS FOR CONSTRUCTION/DEVELOPMENT PERMITS  
ISSUED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY**

July 1, 1985

The Illinois Environmental Protection Act (Illinois Revised Statutes, Chapter 111-1/2, Section 1039) authorizes the Environmental Protection Agency to impose conditions on permits which it issues.

The following conditions are applicable unless superseded by special condition(s).

1. Unless this permit has been extended or it has been voided by a newly issued permit, this permit will expire one year from the date of issuance, unless a continuous program of construction or development on this project has started by such time.
2. The construction or development covered by this permit shall be done in compliance with applicable provisions of the Illinois Environmental Protection Act, and Regulations adopted by the Illinois Pollution Control Board.
3. There shall be no deviations from the approved plans and specifications unless a written request for modification, along with plans and specifications as required, shall have been submitted to the Agency and a supplemental written permit issued.
4. The Permittee shall allow any duly authorized agent of the Agency upon the presentation of credentials, at reasonable times:
  - a. to enter the Permittee's property where actual or potential effluent, emission or noise sources are located or where any activity is to be conducted pursuant to this permit,
  - b. to have access to and copy any records required to be kept under the terms and conditions of this permit,
  - c. to inspect, including during any hours of operation of equipment constructed or operated under this permit, such equipment and any equipment required to be kept, used, operated, calibrated and maintained under this permit,
  - d. to obtain and remove samples of any discharge or emission of pollutants, and
  - e. to enter and utilize any photographic, recording, testing, monitoring or other equipment for the purpose of preserving, testing, monitoring, or recording any activity, discharge, or emission authorized by this permit.
5. The issuance of this permit:
  - a. shall not be considered as in any manner affecting the title of the premises upon which the permitted facilities are to be located,
  - b. does not release the Permittee from any liability for damage to person or property caused by or resulting from the construction, maintenance, or operation of the proposed facilities,
  - c. does not release the Permittee from compliance with the other applicable statutes and regulations of the United States, of the State of Illinois, or with applicable local laws, ordinances and regulations,
  - d. does not take into consideration or attest to the structural stability of any units or parts of the project, and

- e. in no manner implies or suggests that the Agency (or its officers, agents or employees) assumes any liability, directly or indirectly, for any loss due to damage, installation, maintenance, or operation of the proposed equipment or facility.
- 6.
- a. Unless a joint construction/operation permit has been issued, a permit for operation shall be obtained from the Agency before the equipment covered by this permit is placed into operation.
  - b. For purposes of shakedown and testing, unless otherwise specified by a special permit condition, the equipment covered under this permit may be operated for a period not to exceed thirty (30) days.
7. The Agency may file a complaint with the Board for modification, suspension or revocation of a permit:
- a. upon discovery that the permit application contained misrepresentations, misinformation or false statements or that all relevant facts were not disclosed, or
  - b. upon finding that any standard or special conditions have been violated, or
  - c. upon any violations of the Environmental Protection Act or any regulation effective thereunder as a result of the construction or development authorized by this permit.

**From:** "Armitage, Julie" <[Julie.Armitage@Illinois.gov](mailto:Julie.Armitage@Illinois.gov)>  
**Date:** September 7, 2018 at 6:34:23 PM CDT  
**To:** "Hoffman, Kathy" <[KHoffman@sterigenics.com](mailto:KHoffman@sterigenics.com)>  
**Cc:** "Mattison, Kevin" <[Kevin.Mattison@Illinois.gov](mailto:Kevin.Mattison@Illinois.gov)>

By this email, at your request, and to facilitate the shared goal of expedited emissions testing, the Bureau of Air provides notice that it is waiving the timeframe for test plan submittal (30 days prior to testing – condition 6c) and the timeframe for notification of expected and actual test dates (30 and 5 days, respectively – condition 6d) under construction permit No. 18060020 issued June 26, 2018. Also, the Bureau provides notice that, after review and consultation with the USEPA, it is accepting the protocol received August 28, 2018, and supplemented September 7, 2018, conditioned upon the testing scheduled for September 8th, being performed in accordance with USEPA reference methods and supported by a detailed final report that evidences the validity of the test, adherence to reference methods, and compliance with all relevant permit terms.

Should you have comments or questions regarding this matter, pleased direct them to my attention or to that of Kevin Mattison of my staff who will be present for the September 8<sup>th</sup> testing.

State of Illinois - **CONFIDENTIALITY NOTICE:** The information contained in this communication is confidential, may be attorney-client privileged or attorney work product, may constitute inside information or internal deliberative staff communication, and is intended only for the use of the addressee. Unauthorized use, disclosure or copying of this communication or any part thereof is strictly prohibited and may be unlawful. If you have received this communication in error, please notify the sender immediately by return e-mail and destroy this communication and all copies thereof, including all attachments. Receipt by an unintended recipient does not waive attorney-client privilege, attorney work product privilege, or any other exemption from disclosure.



September 7, 2018

Sent via email

Julie Armitage  
Illinois Environmental Protection Agency  
Bureau of Air  
1021 North Grand Avenue East  
Springfield, Illinois 62702

Kevin Mattison  
Illinois Environmental Protection Agency  
Bureau of Air / Compliance Section  
9511 Harrison Street  
Des Plaines, IL 60016

**Re: Waiver Request of Construction Permit Test Notification Requirements, and Additional Test Protocol Information for Sterigenics Willowbrook I and II Facilities  
Facility LD. No: 043110AAC**

Ms. Armitage and Mr. Mattison:

In our recent conversations, we discussed our shared interest in conducting performance testing of the Willowbrook facilities' control equipment as quickly as possible after recently tying in our sterilization chamber backvents into each facility's existing emission control equipment. This letter formally requests IEPA's waiver of the 30 and 5 day performance test notification requirements found in the project's Construction Permit (Application No. 18060020), at Conditions 6 c. and 6 d. If the waiver of notification requirements is granted, then we would plan to commence performance testing beginning in the morning on Saturday, September 8 at approximately 7:00am at Willowbrook I, 7775 Quincy Street. Testing at Willowbrook II will commence at approximately noon.

This letter also provides additional information regarding the previously submitted test protocol we submitted in our last letter. Based on guidance from Mr. Mattison, this information will serve to provide further details about the planned test procedures and how test results are to be generated. With this additional information, we also request that IEPA grant its approval of the updated test protocol.

Please contact me to further discuss this matter. You can reach me at 630-928-1771 or email: [kwagner@sterigenics.com](mailto:kwagner@sterigenics.com).

Regards,

Kevin Wagner  
Director, EH&S

Enclosures:

## **Test Protocol Addendum for both Willowbrook I and Willowbrook II**

### **2.0 EQUIPMENT**

Process parameters for both AAT emission control devices will be measured prior to testing. One measurement of the scrubber would be representative of scrubber conditions throughout the testing. Based on the total volume of the scrubber liquor, it isn't anticipated that an appreciable change in liquor level or pH will occur over the course of testing. In accordance with the site's air permit the scrubber tank level will be measured along with the liquor pH.

### **3.0 TESTING**

Once a sterilization chamber cycle ends, our process requires the chamber door to be partially opened for 15 minutes which vents the EO in the chamber to reduce levels in the chamber and exposure to employees. The 15-minute duration ensures the highest concentration of EO is removed from the chamber prior to unloading the product. During this venting, EO exhausts thru the backvent and to the AAT scrubber. In accordance with our procedures, workers are not allowed to enter or unload the chamber until the 15-minute time period has passed. Once the 15-minutes has passed, the product is unloaded to the aeration room.

The Willowbrook facility utilizes different sterilization cycles based on FDA validated cycles. The EO concentration in the chamber prior to the backvent phase can vary. Therefore, the higher ending concentrations will represent the highest amount of EO exhausted thru the backvents to the AAT scrubber.

In order to meet Condition 6 of the Construction Permit, each test run will be completed on the backvents using freshly sterilized product from one chamber for a 15-minute duration, for a total of three test runs at each facility. The emission testing will use chambers with higher ending EO concentrations for testing. Each test interval will test the first 15-minutes the backvent is opened and exhausted to the scrubber. Once the 15 minutes ends, product will be unloaded from the chamber and placed into the aeration rooms which are continuously vented to the same AAT scrubber throughout the test.

#### **Recording data**

Sterigenics will record process data during the performance testing to identify which chamber was utilized and the sterilization cycle number for each test. This process data will be summarized in a table which will be provided in the final report. In addition to the process data collection, Sterigenics will record pH and scrubber liquor level of the AAT scrubber prior to the test. This information will also be

furnished with the process data in the final report. Due to the AAT scrubber size and design, these parameters do not change significantly during the course of a day which exceeds the performance testing duration.

## **SECTION 5.0 TEST METHOD REFERENCE**

The protocol indicated the CO<sub>2</sub>/O<sub>2</sub> will not be measured, rather the stack will be assumed to be ambient air. The assumed molecular weight of the stack gas will be 29.

### **5.2 VOLUMETRIC FLOW MEASUREMENT**

Method 2C will be utilized to test volumetric flow. The sample port used for the Method 18 inlet and outlet will be used for Method 2C. Please see attached Figure 1 for a drawing of the test locations in accordance with USEPA Method 1 or 1a. The absence of cyclonic flow will be verified during the test program.

### **5.4 SAMPLE TRANSPORT**

In addition to the description of the sample transport in the protocol, the lines used for testing will be heated above 110°C. Source gas will be pumped to the GC with a response time of 5-10 seconds.

### **5.7 CALIBRATIONS**

Calibration will be performed in triplicate prior to and at the end of each test day. Limit of detection will be determined.

## **6.0 TEST SCENARIO**

As discussed above, backvent testing will be performed during normal process load conditions, with freshly sterilized product in the sterilization chambers. Three test runs will be conducted in series to verify the performance of the emission-control system.

Sterilization chamber cycles can range from 8 – 12 hours. Sterigenics will schedule three chambers to end the sterilization cycle to allow for the three test runs to run consecutively, however, due to the range in cycle time, it may be necessary to wait for the chamber cycle to end prior to beginning the subsequent testing.

The sample testing will begin at approximately 7:00 am on Saturday, September 8, 2018. The equipment will be set up Friday evening. Calibration of the chromatograph system will be completed prior to beginning the test at Willowbrook 1 and then again prior to beginning the test at Willowbrook 2.

**Test Scenario Time Line**

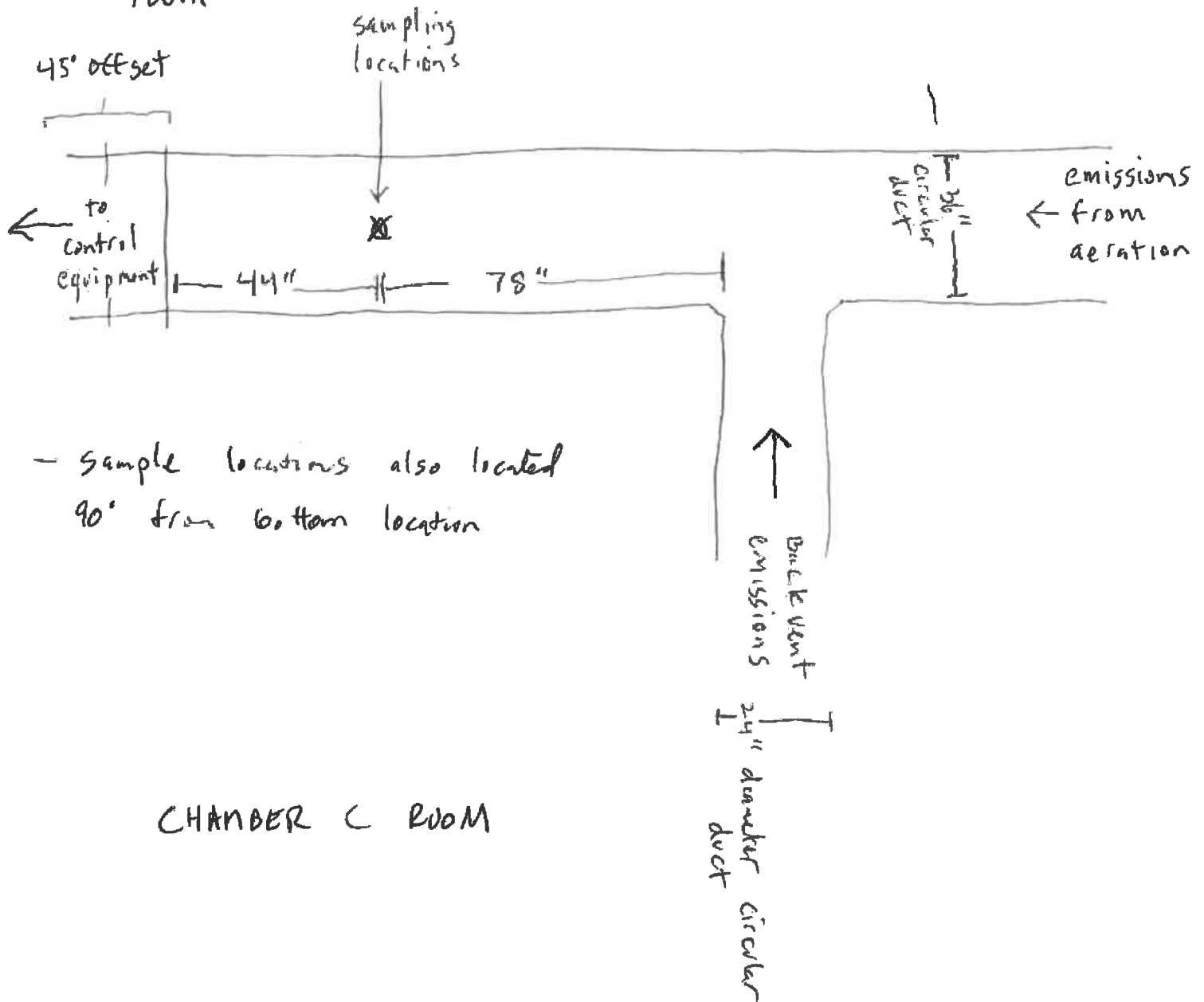
	<b>Sequence for each facility</b>	<b>Method/Reference</b>
	Sample port locations established	Method 1
	3-point calibration performed in triplicate.	Method 18
	Obtain meteorological data for sampling time. Conduct calculation based on Method 4.	Method 4
<b>SAMPLE 1</b>	Flow traverse of inlet and outlet conducted to establish measurement centroid, confirm absence of cyclonic flow.	Method 2
<b>7:00 am</b>	Chamber door opened, actuator switch activates backvent	N/A
	First sample initiated	Method 18
	Samples at Inlet and outlet taken approximately every 1-minute for a total of 15-minutes	Method 18
	Flow monitoring sampled approximately every 1-minute.	
	Recovery study performed	Method 18
Each sample run will follow the same steps as sample 1		
<b>End of 3 samples</b>	Post calibration	



WB I

# INLET TEST LOCATION

- view is looking above at ceiling of chamber C room

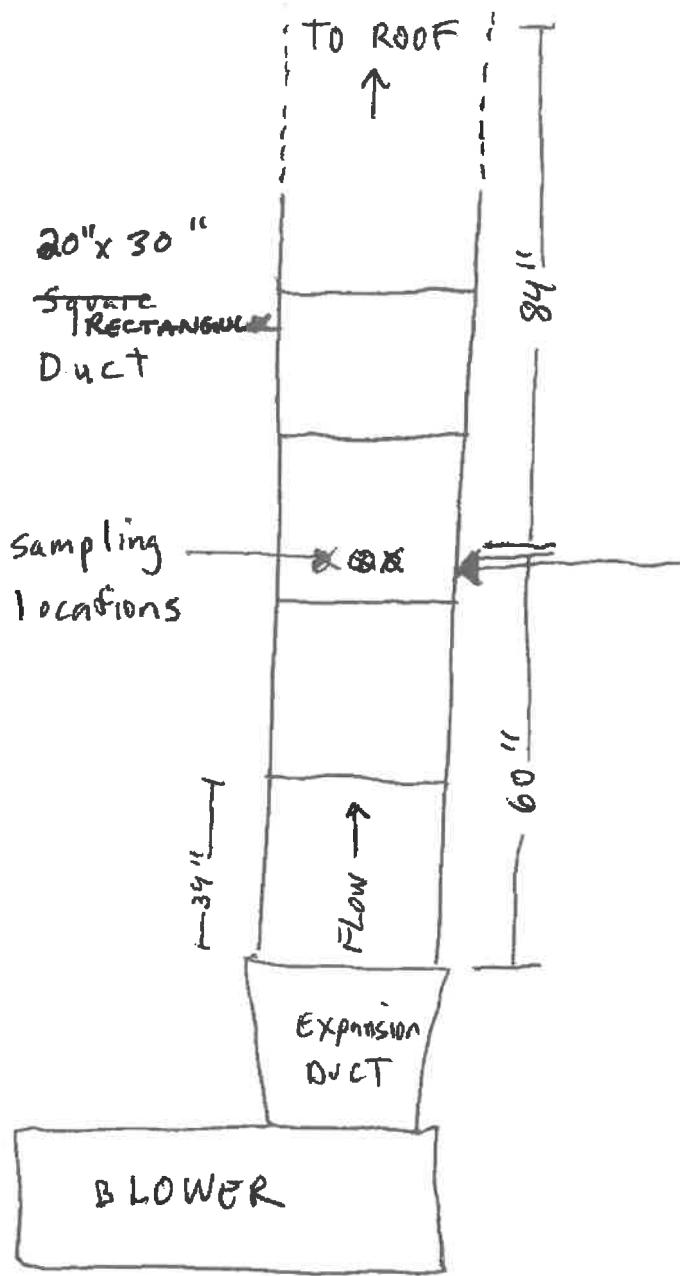


- sample locations also located 90' from bottom location

CHAMBER C ROOM

WB I

# OUTLET TEST LOCATION



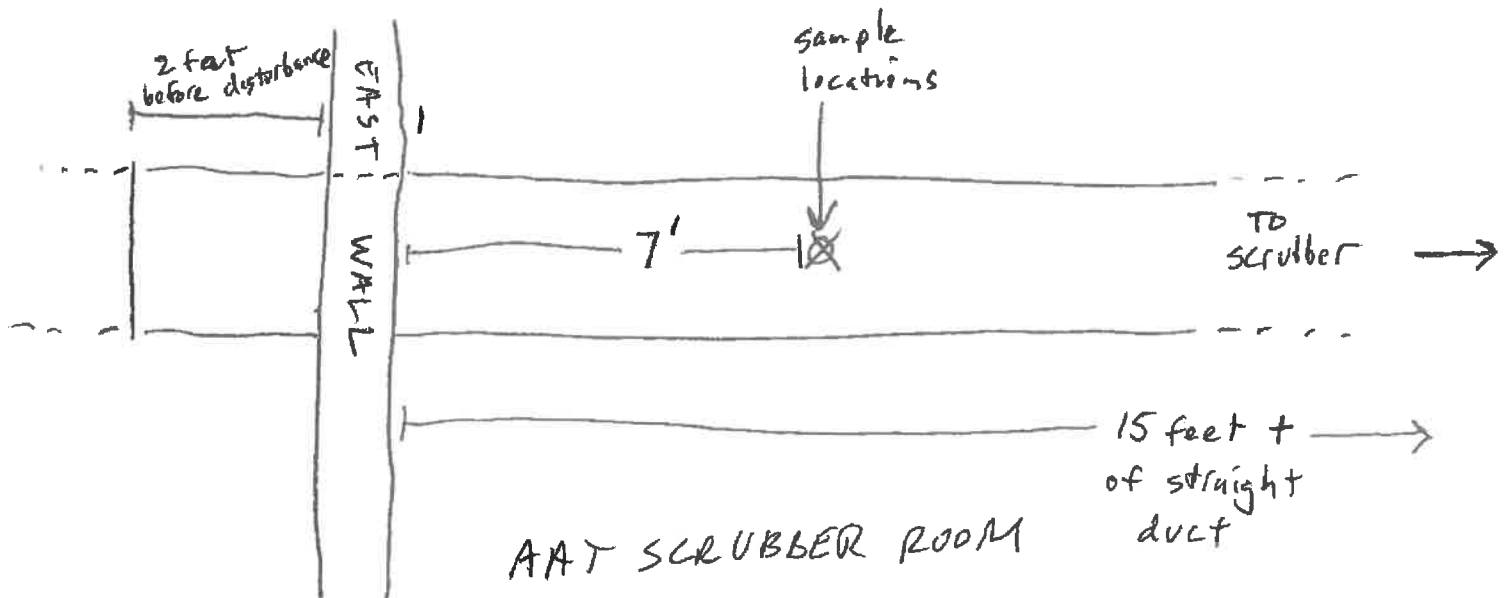
- Main stretch of ducting is 20" x 30" ~~square~~ rectangular duct

- Sample points are located 84" ~~from~~ below top-most disturbance and 60" above lowest disturbance

AAT DRYBED ROOM

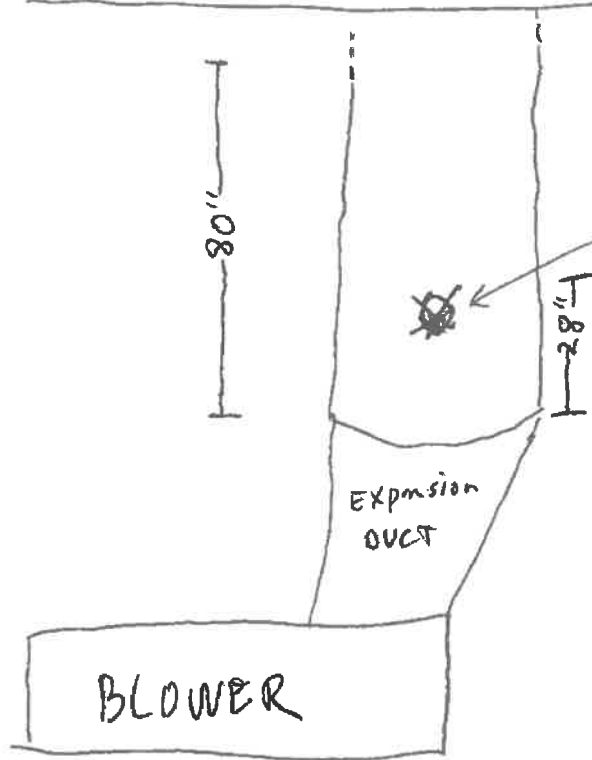
## WB II INLET TEST LOCATION

- View is looking up at ceiling of AAT Scrubber Room



- sample locations also located 90' from bottom location

# WB II OUTLET TEST LOCATION



- 28" diameter circular duct

- Sample locations also located 90' from front location

Sample locations

AAT DRY BED ROOM

\* Sample point will be located in straight run. Verified to meet Method prior to test.

**TEST PROTOCOL FOR  
AIR POLLUTION SOURCE TESTING  
OF AN ETHYLENE OXIDE EMISSION-CONTROL SYSTEM  
OPERATED BY STERIGENICS US, LLC.  
AT ITS WILLOWBROOK I, ILLINOIS FACILITY**

Submitted to:

**ILLINOIS ENVIRONMENTAL PROTECTION AGENCY  
1021 North Grand Avenue East  
Springfield, Illinois 62794**

Submitted by:

**STERIGENICS US, LLC.  
7775 South Quincy Street  
Willowbrook, Illinois 60521**

**I.D. Number 043110AAC**

Prepared by:

**ECSI, INC.  
PO Box 1498  
San Clemente, California 92674-1498**

Prepared on:

**August 24, 2018**

*ECSi*

## CONTACT SUMMARY

### CLIENT

Ms. Laura Hartman  
Manager of Environmental Health and Safety  
STERIGENICS US, LLC.  
2015 Spring Road, Suite 650  
Oak Brook, Illinois 60523

Phone: (630)928-1724  
FAX: (630)928-1701  
email: [lhartman@sterigenics.com](mailto:lhartman@sterigenics.com)

Mr. Paul Krett  
General Manager  
STERIGENICS US, LLC.  
7775 South Quincy Street  
Willowbrook, Illinois 60521

Phone: (630)654-5151  
FAX: (630)325-0020  
email: [pkrett@sterigenics.com](mailto:pkrett@sterigenics.com)

### TEST DATE

September 20-21, 2018

### REGULATORY AGENCY

Daniel Rowell  
Environmental Protection Engineer III  
Bureau of Air – Air Permits Section  
Illinois Environmental Protection Agency  
1021 North Grand Avenue East  
Springfield, Illinois 62794-9276

Phone: (217)558-4368  
FAX: (217)524-5023  
Email: [daniel.rowell@illinois.gov](mailto:daniel.rowell@illinois.gov)

### TESTING CONTRACTOR

Daniel P. Kremer  
President  
ECSi, Inc.  
PO Box 1498  
San Clemente, California 92674-1498

Phone: (949)400-9145  
FAX: (949)281-2169  
email: [dankremer@ecsi1.com](mailto:dankremer@ecsi1.com)

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## 1.0 INTRODUCTION

ECSi, Inc. proposes to conduct air pollution source testing of the ethylene oxide (EtO) emission control system operated by Sterigenics US, LLC. at their Willowbrook I facility, located at 7775 S. Quincy Street. The device to be tested is the two stage AAT Safe Cell packed tower scrubber/dry bed reactor emission-control system, which is used to control emissions from fourteen sterilizer backvents and three aeration rooms. The purpose of the testing program will be to demonstrate compliance with backvent emission control requirements and the conditions established in the Air Quality Permit granted to Sterigenics by the Illinois Environmental Protection Agency (IEPA).

We have specialized exclusively in the performance of ethylene oxide source testing and leak testing since 1992, and are the nationally recognized expert in the field. When the current ethylene oxide emissions regulations were being implemented, we worked closely with the California Air Resources Board (CARB) and USEPA to help develop the currently used testing methodology.



## 2.0 EQUIPMENT

At Willowbrook I, sterilizer backvent emissions are controlled by:

- One two-stage Advanced Air Technologies Safe Cell emission-control system, comprised of a packed-tower chemical scrubber (SC1), equipped with a packed reaction/interface column, a scrubber fluid recirculation system, and a scrubber fluid reaction/storage tank, and a dry bed reactor/scrubber (SC2), comprised of a bank of solid-bed reaction vessels, connected in parallel, installed downstream of SC1 and upstream of a dedicated blower exhaust system.

### 3.0 TESTING

EtO source testing will be conducted in accordance with the procedures outlined in USEPA CFR40, Part 63.365, using USEPA Method 18 as specified. EtO emissions monitoring will be conducted simultaneously at the inlet and outlet of the Safe Cell System (the inlet of SC1 and the outlet of SC2) during the entire duration of the backvent phase of one of the fourteen sterilizers. A total of three backvent-phase test runs will be performed.

During the backvent phase, EtO emissions at the inlet and the outlet of the Safe Cell System will be determined using direct source sample injection into a gas chromatograph (GC). All testing will be conducted during normal process load conditions. All backvent testing will be performed with freshly sterilized product in the sterilizer. The testing program will be conducted in accordance with the procedures outlined in the following sections.

## 4.0 RULE/COMPLIANCE REQUIREMENTS

The EtO gas-sterilization system at the Willowbrook I facility is being tested to demonstrate compliance with EPA requirements, as specified in the IEPA Air Quality Permit. The following requirements must be met:

- The sterilizer backvent phase emissions must be vented to control equipment with an EtO emission-reduction efficiency of at least 99 % by weight.

Testing is required to demonstrate compliance with these requirements. Source testing of the emission-control system is required initially, and may be required periodically thereafter.

## **5.0 TEST METHOD REFERENCE**

### **5.1 INTRODUCTION**

EtO source testing will be conducted in accordance with the procedures outlined in USEPA CFR40, Part 63.365, using USEPA Method 18 as specified. EtO emissions monitoring will be conducted simultaneously at the inlet and outlet of the Safe Cell System during the entire duration of the backvent phase of one of the fourteen sterilizers. A total of three backvent-phase test runs will be performed.

During the backvent phase, EtO emissions at the inlet and the outlet of the Safe Cell System will be determined using direct source sample injection into a gas chromatograph (GC). All testing will be conducted during normal process load conditions. All backvent testing will be performed with freshly sterilized product in the sterilizer. The testing program will be conducted in accordance with the procedures outlined in the following sections.

Operation and documentation of process conditions will be performed by personnel from Sterigenics, Inc. using existing monitoring instruments installed by the manufacturer on the equipment to be tested. In accordance with the procedures established in USEPA CFR40, Part 63, Subpart O, scrubber liquor level will be recorded.

### **5.2 VOLUMETRIC FLOW MEASUREMENT**

Exhaust gas flow at the outlet of SC2 will be determined by 40 CFR 60, Appendix A, Method 2C, using a standard pitot tube and an inclined-oil manometer. Sampling ports will be located in accordance with 40 CFR 60, Appendix A, Method 1. The test ports will be located far enough from any flow disturbances to permit accurate flow measurement.

Temperature measurements will be obtained from a type K thermocouple and thermometer attached to the sampling probe. Exhaust gas composition will be assumed to be >99% ambient air. Water vapor will be negligible and, based on previous test data, a default ambient value of 3 percent will be used for determination of exhaust gas composition and flow calculations.

### **5.3 CONTROL EFFICIENCY AND MASS EMISSIONS MEASUREMENT**

The EtO concentration at the inlet and outlet of the Safe Cell System will be measured simultaneously following the procedures delineated in USEPA CFR40, Part 63.365. During backvent, vented gas will be analyzed by an SRI, Model 8610, portable gas chromatograph (GC), equipped with the following: dual, heated sample loops and injectors; dual columns; and dual detectors. A flame ionization detector (FID) will be used to quantify emissions at the emission-control device inlet, and a photoionization detector (PID) will be used to quantify emissions at the emission-control device outlet.

### **5.4 SAMPLE TRANSPORT**

Source gas will be pumped to the GC at approximately 500-1000 cubic centimeters per minute (cc/min) from the sampling ports through two lengths of Teflon® sample line, each with a nominal volume of approximately 75 cubic centimeters (cc) and an outer diameter of 0.25 inch. At the outlet of SC2 the sampling ports will be located in the exhaust stack.

### **5.5 GC INJECTION**

Source-gas samples will then be injected into the GC which will be equipped with two heated sampling loops, each containing a volume of approximately 2cc and maintained at 100 degrees Celsius (C). Injections will occur at approximately one-minute intervals during the sterilization chamber backvent phase. Helium will be the carrier gas for both FID and PID.

### **5.6 GC CONDITIONS**

The packed columns for the GC will both be operated at 85 degrees C. The columns will be stainless steel, 6 feet long, 0.125 inch outer diameter, packed with 1 percent SP-1000 on 60/80 mesh Carbopack B.

Any unused sample gas will be vented from the GC system back to the inlet of the scrubber.

### **5.7 CALIBRATION STANDARDS**

The FID used at the inlet will be calibrated for part-per-million-by-volume (ppmv)-level analyses using gas proportions similar to the following:

- 1) 100 ppmv EtO, balance nitrogen
- 2) 50 ppmv EtO, balance nitrogen (audit gas)
- 3) 10 ppmv EtO, balance nitrogen
- 4) 1 ppmv EtO, balance nitrogen

The PID used at the outlet will be calibrated for ppmv-level analyses using gas proportions similar to the following:

- 1) 100 ppmv EtO, balance nitrogen
- 2) 50 ppmv EtO, balance nitrogen (audit gas)
- 3) 10 ppmv EtO, balance nitrogen
- 4) 1 ppmv EtO, balance nitrogen

Each of these calibration standards will be in a separate, certified manufacturer's cylinder. Copies of the calibration gas laboratory certificates will be included with the final report.

## 5.8 SAMPLING DURATION

Backvent EtO measurements will be taken for the entire duration of the backvent phase, which will be 15 minutes. This will encompass a total sampling duration of 15 minutes for each backvent phase test run.

## 5.9 CONTROL-EFFICIENCY/MASS-EMISSIONS CALCULATIONS

Control efficiency of EtO will be calculated for the backvent phase. Control efficiency will be calculated for each data point which will be produced at each injection interval. The time-weighted-average (TWA) EtO control efficiency will be calculated using these results. Results of the control-efficiency testing will be summarized in the final report.

Mass emissions of EtO will be calculated using the following equation:

$$\text{MassRate} = (\text{VolFlow})(\text{MolWt})(\text{ppmv EtO}/10^6)/(\text{MolVol})$$

Where:

MassRate = EtO mass flow rate, pounds per minute

VolFlow = Corrected volumetric flow rate, standard cubic feet per minute at 68 degrees F

MolWt = 44.05 pounds EtO per pound mole  
ppmv EtO = EtO concentration, parts per million by volume  
 $10^6 =$  Conversion factor, ppmv per "cubic foot per cubic foot"  
MolVol = 385.32 cubic feet per pound mole at one atmosphere and 68 degrees F

Mass emissions of EtO will be calculated for backvent. The results will be summarized in the final report.

## 6.0 TEST SCENARIO

Backvent testing will be performed during normal process load conditions, with freshly sterilized product in the sterilizer. Three test runs will be conducted in series to verify the performance of the emission-control system. The testing schedule will be as follows:

- Equipment setup and gas chromatograph calibration.
- Backvent Test Run #1 is performed with freshly sterilized product in one of the fourteen sterilizers. Sampling is performed at the inlet and outlet of the Safe Cell System.
- Backvent Test Run #2 is performed with freshly sterilized product in one of the fourteen sterilizers. Sampling is performed at the inlet and outlet of the Safe Cell System.
- Backvent Test Run #3 is performed with freshly sterilized product in one of the fourteen sterilizers. Sampling is performed at the inlet and outlet of the Safe Cell System.
- Post-calibration check performed and equipment breakdown.



## **7.0 QA/QC**

### **7.1 FIELD TESTING QUALITY ASSURANCE**

At the beginning of the test, the sampling system will be leak checked at a vacuum of 15 inches of mercury. The sampling system will be considered leak free when the flow indicated by the rotameters falls to zero.

At the beginning of the test, a system blank will be analyzed to ensure that the sampling system is free of EtO. Ambient air will be introduced at the end of the heated sampling line and drawn through the sampling system line to the GC for analysis. The resulting chromatogram also will provide a background level for non-EtO components (i.e. ambient air, carbon dioxide, water vapor) which are present in the source gas stream due to the ambient dilution air which is drawn into the emission-control device. This chromatogram, designated AMB, will be included with the calibration data in the final report.

### **7.2 CALIBRATION PROCEDURES**

The GC system will be calibrated at the beginning and conclusion of each day's testing. Using the Peaksimple II analytical software, a point-to-point calibration curve will be constructed for each detector. A gas cylinder of similar composition as the calibration gases, but certified by a separate supplier, will be used to verify calibration gas composition and GC performance.

All calibration gases and support gases used will be of the highest purity and quality available. A copy of the laboratory certification for each calibration gas will be included in the final report.

## 8.0 FINAL TEST REPORT DESCRIPTION

The test results will be summarized in a written report. This report will be submitted to the IEPA no later than sixty days after the conclusion of the field testing. It will include results for EtO control efficiency of the emission-control device and mass emissions of EtO to the atmosphere from the emission-control device outlet. The report will contain:

- Summary tables with comparisons of the test results to rule limits;
- Copies of all intermediate data tables and calculation worksheets;
- Copies of all GC chromatograms from calibration runs and sample injections; and
- Laboratory calibration certificates for all calibration and audit gases and all applicable measurement instruments such as pitot tubes and thermocouples.